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ABSTRACT

The manual is the fourth of six student manuals for use in a course on occupational health and safety for supervisory personnel. The manual contains lessons 8-11 of the 15 consecutively-numbered lessons, each of which contains study questions (and answers) interwoven with the text and review questions at the end of each section. Lesson 8 discusses occupational health and environmental control and covers toxic materials, noise, airborne contaminants, lighting and radiation, and their internal and external effects on the human body. Lesson 9 discusses the basic types of personal protective equipment and covers the use of such equipment, its relation to the Occupational Safety and Health Act, and the implementation of a personal protective equipment program. Lesson 10 covers emergency care procedures and, with the aid of diagrams, discusses measures to counteract cessation of breathing, severe bleeding, and traumatic shock. Lesson 11 discusses fire loss control and covers proper selection and use of fire extinguishers and education of employees in fire protection and control. (JR)

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A Programmed Instruction Course

Principles and Practices of Occupational Safety and Health

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STUDENT MANUAL

Booklet Four

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LESSON 8

OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

In this lesson we will discuss toxic materials, noise, airborne contaminants, lighting and radiation, and their internal and external effects on the human body. You will see how the OSHA standards include Threshold Limit Values (TLVs) for exposure to various toxic materials, and how to control or monitor such exposures.

OCCUPATIONAL HEALTH IS ALSO IMPORTANT

Past safety and health programs in some establishments have dealt more with protecting their employees from safety hazards than from health hazards. As the title of the *OCCUPATIONAL SAFETY AND HEALTH ACT* indicates, employers must be concerned with and aware of the hazards that can cause a deterioration in an employee's health. This lesson will point out where health hazards may exist in your work area and procedures on how to control them. The problem with many on-the-job health hazards is that many diseases caused by these hazards do not show themselves until sometime after exposure. An example of this problem is silicosis in foundry workers. Symptoms of this disease may become evident only after many years of exposure.

Therefore, as you study this lesson, keep in mind that an employee's health is as important as his safety, and that many times what may be considered a safety hazard may also be a health hazard.

OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

There are many health hazards from which workers need to be protected. Reading the paragraph below will help you to understand the type of information on health hazards that you will be learning about in this lesson. It is taken from the OSHA standards under the heading, "OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL" (Section 1910 Subpart G).

> To achieve compliance with . . . this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person . . . (Section 1910.93).

As that points out, you may have to consult an industrial hygienist or some other technically qualified source to see whether your work area meets with the Federal health standards.

WHAT IS AN INDUSTRIAL HYGIENIST?

An industrial hygienist is a person who has been trained in recognizing, evaluating, and controlling environmental factors. The hygienist concerns himself with the chemical, physical, biological, or stress factors that may cause illness, impaired health, or significant physical discomfort to employees.

Therefore, the industrial hygienist can help to control job environmental factors that can affect an employee's health.

Unfortunately, there may not always be an industrial hygienist available to you, so you will need to become familiar with some of the requirements of the OSHA standards in order to combat actual or potential health hazards in your workplace.

WHAT IF AN INDUSTRIAL HYGIENIST IS NOT AVAILABLE?

In some of the lesser populated areas of the country, industrial hygienists may not be available. The following list may help you in determining what health hazards exist in your work area, so you can seek appropriate qualified assistance. (Lesson 14 will deal with this issue in more detail.)

- Your employer's insurance company
- Your company doctor
- Your local public health department
- Your safety department
- Personal protective equipment companies
- Your OSHA Area Director of the Occupational Safety and Health Administration
- Your State Health Department

EMPLOYEE EXPOSURE TO TOXIC MATERIALS

INTERNAL AND EXTERNAL EXPOSURE

Health hazards frequently result in employee over-exposure to toxic materials. There are many toxic materials, some of which you are probably quite familiar with, such as chlorine gas or carbon monoxide.

When an employee becomes over-exposed to toxic materials, his health can be affected either internally (vital internal organs) or externally (skin, sense organs). Therefore health hazards result from both INTERNAL and EXTERNAL exposure to toxic materials.

RESULT OF INTERNAL EXPOSURE

INTERNAL EXPOSURE results in damage to internal organs from harmful or toxic materials entering the body in three ways.

a. By breathing or exhaling contaminants into the respiratory tract or lungs, such as dust, fumes, vapors, mists, or gases.

b. By swallowing contaminants with saliva, water, or food into the digestive tract.

c. By absorption through the skin.

Using the categories above, a., b., and c., classify the following types of internal exposure:

1. Radiation exposure.
2. Eating food contaminated with lead.
3. Exposure to silica dust.
4. Lung disease caused by inhaling toxic dusts.

(Fill in the following blanks.)

ANSWERS TO QUESTIONS:

1. c.

2. b.

3. a.

4. a.

INHALING OF TOXIC MATERIALS

5. An employee is in a work area where he breathes dangerous gas over a period of time is an example of _____ exposure.

6. In your own words, why would inhaling a dangerous gas be called an internal exposure to toxic materials?

SWALLOWING TOXIC MATERIALS

7. There are other ways an employee can be affected internally by overexposure. Accidentally swallowing, or ingesting, toxic materials can lead to _____ exposure.

ABSORPTION OF TOXIC MATERIALS

Another way to be affected internally by toxic materials is by absorption through the skin. Many substances, such as TNT, leaded gasoline, and hydrogen cyanide can produce internal poisoning by direct contact with the skin. If there are wounds such as open cuts, scratches, or breaks in the skin, absorption is still easier.

8. As you can see there are many ways an employee can be affected by toxic materials. This is why it is so important for you to seek help from an industrial _____ or some other qualified person.

TOXIC MATERIALS AFFECT INTERNAL ORGANS AND SYSTEMS

9. Whenever internal organs and systems are affected by toxic materials, whether by swallowing, breathing, or absorption through the skin, the result is called _____ exposure.

RESULT OF EXTERNAL EXPOSURE

10. Another type of health hazard mentioned in the Act is due to EXTERNAL exposure. External exposure can be defined as a contact with the skin or sense organs by harmful elements, or simply too much contact with an ordinarily harmless element. Effects of external exposure can vary quite widely—from skin rashes to severe burns. Do you think exposure to an excess noise level would be a type of external exposure?

    a. Yes

    b. No

ANSWERS TO QUESTIONS:

5. Internal

6. Because exposure of this type is damaging to the internal parts of the body such as the lungs, liver, heart, blood or tissues.

7. Internal

8. Hygienist

9. Internal

10. Yes. Although noise is not a toxic material, it is a physical health hazard that can be detrimental to a sense organ (the ear).

Noise affects the human body in more ways than we have presented here. We will be discussing the effects of noise on our bodies in greater detail later in this lesson.

NOISE AFFECTS OUR SENSES

Exposure to noise affects one of our senses; the sense of hearing. There are five senses: sight, hearing, smell, taste, and touch. Any one of these senses can be affected by external over-exposure to toxic materials, or physical agents.

There are many permanently harmful consequences for employees who are over-exposed to toxic materials. The following table indicates the results of over-exposure to some specific toxic materials or hazardous physical agents.

Sense Organ	Exposure to:	Effect of Extreme Overexposure
Eyes (Sight)	Butyl Alcohol	Loss of Sight
Ears (Sound)	Excessive Noise Levels	Loss of Hearing
Nose (Smell)	Acetic Anhydride	Loss of Sense of Smell
Mouth (Taste)	Chromium	Loss of Sense of Taste
Skin (Touch)	Phenol	Extreme Dermatitis

CLASSIFYING EXAMPLES OF INTERNAL AND EXTERNAL EXPOSURES

11. Up to this point you have been given some examples of internal and external exposures. Classify the following examples as being either internal exposure (I) or external exposure (E):

    a. Swallowing a contaminant that was in your drinking water. _____

    b. Skin rash. _____

c. Inhaling toxic vapors. _____

d. Eyes splashed by harmful chemicals. _____

e. Burns on the skin from chemicals. _____

f. Breathing harmful mist. _____

EFFECT OF CHEMICALS ON THE SKIN

External exposure to certain chemicals can defat the skin. This means that the exposure removes the skin's protective oils and makes it more susceptible to injury. An example of a chemical that will defat the skin is acetone. Defatting of the skin is an example of an external exposure.

There are many ways that chemicals and other toxic materials can affect the human body. You will receive many more specific examples of the effects of internal and external exposure throughout this lesson. However, the treatment of this subject is a comprehensive course in itself, and cannot be covered completely here. If your function involves dealing with toxic materials, noise, or other health hazards, it is your responsibility to learn everything possible about the hazards and their alleviation.

It is an important part of your job as a supervisor to educate your employees about the effects of any toxic materials they work with and the effects on their working environment. It is important to remember that you should constantly be teaching your employees about how to remain safe and healthy even though they may have to work with toxic materials daily.

To help you educate those you supervise on health hazards, we will discuss with you the different types of exposure your employees may come in contact with, and how to remedy the problems.

WHAT ARE INTERNAL AND EXTERNAL EXPOSURES

12. For review purposes, in your own words, define internal and external exposure. _____
_____
_____
_____

THRESHOLD LIMIT VALUE

The first specific type we will talk about is called exposure to AIRBORNE CONTAMINANTS. When referring to the OSHA standards, you will find a term that is used frequently. This term is THRESHOLD LIMIT VALUES (TLV). TLV refers to airborne concentrations of substances, and represents limits under which nearly all employees may be exposed without adverse effects. Threshold limit values are stated in terms of time weighted concentrations for an 8-hour workday and 40-hour workweek.

Every employer must adhere to the Threshold Limit Values that correspond to the toxic materials or conditions his employees work under. All of these TLVs can be found in the OSHA standards.

ANSWERS TO QUESTIONS:

11. a. Internal b. External c. Internal

    d. External e. External f. Internal

12. Internal exposure - exposure to materials that damage internal organs, tissues, or systems.

    External exposure - exposure to harmful materials that affect the skin and sense organs.

EMPLOYEES ARE AFFECTED DIFFERENTLY

Since people react differently under certain circumstances, some employees will be affected by a contaminant that is at or below the Threshold Limit Value concentration figure in the OSHA standards.

There are several reasons why some employees might be affected by a contaminant below a set TLV. One reason might be that a particular individual has a lower tolerance level to the toxic materials he works with. Another reason would be that the employee might have another health problem that makes him more susceptible to exposure. For example, he might have previously had a skin disease that might be irritated by a contaminant he works with.

TLVs ARE MAXIMUM LIMITS

TLVs are maximum limits prescribed by OSHA standards. Since employees may react differently to contaminants, you need to use your knowledge of those you supervise to determine whether they would need to work with less exposure to the contaminant.

As stated at the beginning of this lesson, your best source in helping you determine whether employees are being overexposed is the industrial hygienist or another qualified source. He has the knowledge and background to give expert advice on health problems.

WHAT TO DO IF A HYGIENIST IS NOT AVAILABLE

13. What are some of the other sources for help if an industrial hygienist is not available? (See if you can name four.)

    a. _____

    b. _____

    c. _____

    d. _____

Since a copy of the *FEDERAL REGISTER* is furnished with this course, let's do a short hypothetical exercise, using a common toxic substance, to determine compliance with the OSHA standard. Instructions for computing an employee's exposure begin on page 23540, Section 1910 Subpart G. The text explains how to use the TLV tables (G-1, G-2 and G-3) on pages 23541, 23542 and 23543 as a reference.

ANSWERS TO QUESTIONS:

12. a. insurance company

    b. company doctor

    c. local public health service

    d. safety department

    e. OSHA area director of the Occupational Safety and Health Administration

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Look at Table G-1 and find "Carbon Monoxide" in the first column. The TLV for this toxic substance averaged over an 8-hour work shift for a 40-hour workweek is:

> 50 parts of the gas per million parts of the contaminated air OR 55 milligrams per cubic meter of air. (55 ppm or 55 mg/M^3) (Obviously, you will need an air sampling device to determine the amount of contamination. This would be the time the industrial hygienist would come in.)

Presume that one of the employees is exposed to this gas each day at a rate of 4 hours at 75 ppm and 4 hours at 30 ppm. The formula in 1910.93(d) (1) (ii) would be used, (Page 23540) as follows:

$$\frac{4 \times 75 + 4 \times 30}{8} = 52.50$$

In this case, the TLV is being exceeded, and your work area for this employee is not in compliance with the standard.

Now consult paragraph (e) on page 23541 to see how you could come into compliance.
"Administrative"—You could reduce the employee's time of exposure.
"Engineering"—You could improve ventilation of the work area.
"Protective Equipment"—Perhaps an approved respirator.

In the case of carbon monoxide, you can average out the daily exposure and stay within an 8-hour limit. Some other toxic substance exposures CANNOT be averaged over the 8-hour day. These are preceded by the letter "C" for "Ceiling Limit" in Table G-1. Find "C Chloroform (Trichloromethane)" in the first column.

Since this toxic substance is preceded by the letter "C," the values 50 ppm or 240 mg/M^3 cannot be exceeded for ANY length of time.

14. As a brief review, answer the following questions concerning threshold limit values, using the OSHA Standards in your *FEDERAL REGISTER.*

    a. What is the TLV for L.P.G. (Liquefied Petroleum GAS)?

    b. Is there a "Ceiling Limit" on vanadium dust?

    c. Employees are engaged in a process using turpentine. Over an 8-hour period, they will be exposed to 600 ppm. Is the TLV for this substance being exceeded?

ANSWERS TO QUESTIONS:

14. a. 1000 ppm or 1800 mg/M^3
    b. Yes
    c. No. (TLV is 100 ppm. Their average exposure is 75 ppm.)

Lesson 2 brought up the point that a RECORD must be kept of all employees who have been overexposed to a contaminant causing an occupational illness. Therefore, it is important to know the types of TLVs that are found in the *FEDERAL REGISTER*.

These standards cover the specific contamination problem associated with dust, fumes, mist, gas, and vapor. We will discuss some of these so that you can recognize these health hazards as well as ways to help you control these hazards.

DUST

DUSTS are airborne particles generated mechanically from operations such as: drilling, cutting, blasting, crushing, and grinding. Dust particles are measured in microns (microns are about 1/25,000 of an inch in size). Most dust averages between 1/2 to 3/4 of a micron. Dust particles can therefore not be seen by the human eye.

FUME

Another airborne contaminant is FUME. Fumes are solid particles that are produced by condensation of vapor usually accompanied by chemical changes. Examples are: welding, burning, and decomposition by heat. The most common fumes are caused by the oxidation of a metal. Fumes are usually smaller than dust and range generally below 1 micron, hence they likewise cannot be seen by the naked eye.

THE EFFECT OF DUST ON EMPLOYEES

15. Dust can affect an employee's skin, eyes, and lungs. Could the effect of dust on an employee be called internal exposure, external exposure, or both?

    a. Internal exposure

    b. External exposure

    c. Both a. and b.

CLASSIFYING DUST AND FUMES

16. Classify whether the following can cause dusts (D) or fumes (F) exposures:

    a. Melting metal or plastic
    b. The embers in a forge
    c. Stone cutting
    d. Sand blasting
    e. Welding

ANSWERS TO QUESTIONS:

15. c. Both internal and external

16. a. fumes
    b. fumes
    c. dust
    d. dust
    e. fumes

MIST

Another airborne contaminant is MIST. Mists are particles of liquids or mixtures of liquids and solids. The size of a mist depends upon the process by which it is made. An example is the chromium plating process.

GAS

Another airborne contaminant is GAS. Gas is a low density material that can expand and contract when it comes into contact with different ranges of temperature and pressure. A gas can be changed to a liquid or solid by proper changes of both temperature and pressure.

An example of this type of airborne contaminant would be a gasoline engine propelled forklift that puts out carbon monoxide in the form of a poisonous gas. An employee should take extreme care when he operates a gasoline propelled vehicle in a closed space.

VAPOR

The last airborne contaminant we will discuss is called VAPOR. Vapors are gaseous forms that normally are in the solid or liquid state at room temperature. Most vapors can be changed back to a solid or liquid state by EITHER increasing the pressure or decreasing the t mperature. This differentiates vapors from gases since gases change to a solid or liquid by changing both temperature AND pressure.

17. Mists, dust, and fumes are all forms of _____ _____contaminants.

18. When you boil water, do you get a gas or a vapor?

    a. Gas

    b. Vapor

19. If you inhale a vapor for a long period, the effects would be called an _____ exposure.

    a. Internal

    b. External

ANSWERS TO QUESTIONS:

17. airborne

18. b. Vapor. You are only changing the temperature of the liquid.

19. a. Internal

---

20. If vapor, mist, gas, fumes, or dust in your work area irritates your EYES, the effect would be called an _____ exposure.

    a. Internal

    b. External

21. If one of these airborne contaminants makes you cough, the effect would be called an _____ exposure.

    a. Internal

    b. External

VENTILATION IS IMPORTANT

Although you can't see particles of an airborne contaminant, you can, of course, see the effect of all the particles on yourself and those you supervise. It's not hard to tell what the problem is when you and your employees are choking because of a heavy concentration of dust or fumes.

Adequate ventilation is one of the most effective ways to eliminate airborne contaminants from your work area.

An adequate ventilation system causes fresh air to circulate and replace contaminated air.

USE PROTECTIVE EQUIPMENT AS LAST RESORT

If it is not feasible to install proper ventilation or other engineering or administrative controls in your work area, the next best procedure is to use respiratory protective equipment. You should keep in mind that respiratory equipment should be used as a last resort. Always try to eliminate a hazard before you resort to protective equipment.

ADDITIONAL BODY EFFECTS BY CONTAMINANTS

Up to this point we have discussed the effects of airborne contaminants on the human body. Besides the effects of hazardous materials already mentioned (for dust, mist, gas, fumes, and vapors), there are other ways the body is affected.

ANSWERS TO QUESTIONS:

20. b. External

21. a. Internal

Most hazardous materials can be classified by the way they affect the body. The body effects listed below are additions to those already mentioned for airborne contaminants.

a. Irritant materials that attack the lungs.

b. Asphyxiant materials that combine with the blood to prevent the normal transfer of oxygen to the tissues.

c. Anesthetic and narcotic materials that cause sleepiness and nausea.

d. Systemic poisons that attack the vital organs of the body such as the liver and kidneys.

Using the information in the previous paragraph classify the information by hazardous materials (using the notations a., b., c., d.).

22. A material that causes a worker to pass out because of lack of oxygen. _____

23. A material that interferes with normal breathing. _____

24. A material that affects the heart. _____

25. Nausea associated with vapor degreasing. _____

26. All of the exposure effects listed in above item can be called _____ exposure.

a. Internal

b. External

ELIMINATE AIRBORNE CONTAMINANTS

27. As has been indicated, airborne contaminants cause serious effects on the body. What is one method used to eliminate airborne contaminants from your work area?

---

28. If elimination of the hazard is impossible, what is the last method you should use to protect employees?

We will discuss the different types of respiratory protective equipment available for your use in Lesson 9.

ANSWERS TO QUESTIONS:

22. b.

23. a.

24. d.

25. c.

26. a. internal

27. proper ventilation

28. use of appropriate respiratory protective equipment

HAVE THE CONTAMINATION LEVEL MEASURED

Whenever you feel that employees are being affected by airborne contaminants, you should attempt to have the level of contaminant measured by a qualified person. There are many devices to measure airborne contaminants. The type of device depends upon the type of particles to be sampled. Some of the OSHA standards require employers to make periodic samples.

One of the most common techniques for collecting samples of airborne dust is a filter. Dust collected by this method can be measured by chemical weight or particle size analysis.

Another sampling device is called an impinger. It samples most air contaminants. This device works by directing a jet of air so that it strikes (impinges on) a flat surface immersed in a liquid collecting medium. The contaminant is deflected by the flat surface and captured in the liquid.

CHECK THE OSHA STANDARDS

Once an expert collects the air samples from your work area, he would need to check the level of the contaminant with the list of TLV in the OSHA standards.

If the level of the airborne contaminant measured is above the stated TLV, your employer is in violation of the standards.

CONTROL AIRBORNE CONTAMINANTS

As was stated in Lesson 4, one part of your job is to help control hazards. Some of the ways to control airborne contaminants are:

- Substitution of less toxic materials;
- Enclosure of harmful processes;
- Isolation of harmful processes;

- Local exhaust ventilation;
- General ventilation;
- Use of wet method (such as water on a grinding wheel);
- Use of personal protective equipment;
- Decreased daily exposure for employees (this is referred to in the OSHA standards as an administrative control).

Match the control steps in Column A (information given in above item) with the examples in Column B:

Column A		*Column B*
29. Substitution of less toxic materials.	_____	a. Placing hazardous operations in another building away from employees.
30. Enclosure of harmful processes.	_____	b. Vapors are drawn out of an oil tank.
31. Isolation of harmful processes.	_____	c. Substituting a water-based paint for a paint with a high solvent content.
32. Local exhaust ventilation.	_____	d. Respirators are used.
33. General ventilation.	_____	e. Removal of air from a general area.
34. Use of the wet method.	_____	f. Enclosing radioactive material.
35. Use of personal protective equipment.	_____	g. Job rotation to control for exposure.
36. Decreased daily exposure for employees.	_____	h. Using water on a grinding wheel.

INJURIES TO THE SKIN

The Federal standards cover many things with regards to protecting employees from health hazards. Below is an example of one of them:

> "Sufficient washing facilities, including soap, individual towels, and hot water shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin, on the basis of at least one basin (or its equivalent) with a hot water faucet for every 10 employees." 1910.94(d) (9) (ix)

To decide whether your washing facilities need to be upgraded, one factor you need to know is whether the liquids employees work with will burn, irritate, or otherwise be harmful to the skin.

ANSWERS TO QUESTIONS:

29. c.	30. f.	31. a.
32. b.	33. e.	34. h.
35. d.	36. g.	

A PHYSICIAN SHOULD BE CONSULTED

Other OSHA standards require employees who develop sores, burns, or other skin lesions to seek medical treatment before they can go back to work. Below is the actual wording of this standard:

> Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chances of exposures to the chemicals are removed. 1910.94(d) (9) (viii)

If an employee works with chemicals and has a cut or open sore, the chances are good that he will develop complications because of the cut.

ADEQUATE VENTILATION IS NEEDED

Good ventilation is important in many work areas. Some employees are killed because certain tests are not made before they enter a tank for cleaning, inspection, or maintenance. The frequency of death is so great that many employers require permits before an employee can enter a tank. Here is an example of recommended actions in regard to proper "tank entry procedure." Most of these actions are required by OSHA standards (1910.94(d) (11)). Before entering a tank, several precautionary measures are prescribed:

- Control valves that let material into the tank are padlocked shut;
- The atmosphere is tested to make sure enough oxygen is present;
- Test to see whether toxic elements or flammable air contaminants are present;
- Sufficient ventilation is provided for as long as the employee is in the tank to take out the hazardous atmosphere;
- The buddy system is used together with use of a lifeline;
- Both men are trained for emergency procedures.

37. The use of ventilation in an operation such as tank cleaning is a good example of the _____ of hazards.

    a. Control

    b. Segregation

ANSWERS TO QUESTIONS:

37. a. control

CONTACT DERMATITIS

A common health hazard that develops from prolonged contact with chemical agents is called CONTACT DERMATITIS (inflammation of the skin). This type of health hazard can be termed an external exposure.

Some people are more susceptible than others to contact dermatitis. People with lightly pigmented skin (fair complexion) are very susceptible because their skin is easily irritated. Those with dry skin are quite susceptible to desiccants (drying agents). Hairy skin is more prone to folliculitis (inflammation of the hair follicles).

CAUSES OF DERMATITIS

There are several direct causes of dermatitis. These are:

- Mechanical
  - –friction
  - –pressure
  - –trauma
- Physical
  - –heat
  - –cold
  - –radiant energy
  - –ultraviolet light
  - –x-ray
- Biological
  - –bacteria
  - –fungi
  - –parasites
- Chemical
  - –inorganic and organic irritants and sensitizers
  - –plants and woods

Medical treatment is advisable if any employees develop an inflammation of the skin. Whenever inflammation of the skin develops, contact dermatitis should be suspected.

Educating employees to the importance of personal hygiene is necessary. Unwashed skin and unchanged clothes prolong contact with chemical agents and increase the probability of inflammation of the skin.

Chances of contact dermatitis are greater in warmer weather because of the use of fewer clothes. In the summer, employees probably will wear short sleeve shirts, which means more skin area will be exposed to chemical agents.

As in all hazards, you must determine ways they can be controlled. As mentioned in several previous lessons, the three ways to control hazards is to eliminate, segregate, or supply personal protective equipment.

Whenever health hazards are present, one way to help control for the number of injuries is to tell employees of the hazard and to train them in prevention or protection procedures.

The most effective way to train employees is to show them what types of prevention and protection procedures are open to them. If they are to use protective equipment (discussed in more detail in Lesson 9), it is critically important to teach them—and insist on—proper use of the equipment.

Additional injuries may result if employees are not properly trained in the use of protective equipment.

THE EFFECT OF NOISE ON THE EAR

Another health hazard that may affect the employees in your work area is NOISE. Excessive noise can be considered mainly an EXTERNAL exposure.

Prior to 1948, the effect of noise hazards on workers was not regarded as significant to some employers. As more information was gathered, it became evident that many employees were suffering from acute hearing losses due to the noise levels in their work area. To effectively combat the problems of excess noise in your work area, you should understand some of the basic concepts of sound and noise levels.

WHAT IS NOISE?

The noise level of any operation is measured in terms of DECIBELS (dB). A decibel is the measurement of the intensity of a sound. Different sounds have different decibel levels. For example, the intensity of a soft whisper is about 30 dB, normal speech is about 73 dB, and a jet airplane gives off an intensity level of about 160 dB. If you have ever been near a jet airplane when the engines were on, you will probably remember how loud and possibly painful the noise was.

One important point to remember, with regard to sound, is that a hearing loss usually occurs only after an employee has been exposed to a noise level over a period of time. For example, we listed the intensity level of a jet airplane as 160 dB. If you were at an airport and were near the airplane for a short time, you wouldn't experience a permanent hearing loss. But if you had to work near airplanes all day, and didn't wear ear protection, you would eventually experience a hearing loss.

The OSHA standards are very exact on the limits of the intensity of noise that a worker can tolerate without suffering a hearing loss. Below is a list of exposure levels a worker can tolerate for a certain number of hours per day over a long period of time.

Maximum Hours of Exposure per Day	Sound Level Measured in dBA
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

As you have probably noticed in the sound levels noted above, the notation dBA is used. We have already explained what decibel (dB) means, but not the letter "A." The "A" stands for a scale on a sound level meter. This scale approximates the range of a person's hearing. Whenever a qualified person measures the noise level in your work area, he will use a sound meter.

When you feel noise exists in your work area, you should request a noise survey be done. If excessive noise exists, temporary measures, such as ear plugs or ear muffs, should be instituted immediately, while steps for a permanent solution are being taken. Industrial hygienists or safety and health specialists can help to recommend the best course of action.

You may likewise seek help from your company doctor or your local public health service. It would also be helpful to have employees' hearing checked by an audiometrist to see if they are suffering from a hearing loss.

38. Take a look again at the exposure limits. How many hours per day could employees work in an area that was measured to be 100 dBA?

    a. One hour

    b. Two hours

    c. Three hours

    d. Four hours

AN EMPLOYEE CAN LOSE HIS HEARING

39. If the noise is loud enough and over a long period of time, an employee may develop a _____ hearing loss.

    a. Temporary

    b. Permanent

Not only does noise affect the ability to hear, it also affects the body itself. Noise can cause changes in the size of blood vessels, restricting the flow of blood, making the heart work faster. Noise also affects the brain, causing blood vessels to enlarge and produce headaches. Other body organs, such as the kidneys, also are affected by noise.

Excessive noise affects the rest of your body and therefore can also be an INTERNAL exposure.

Noise can also stimulate an individual to a nervous peak. Momentary lapses of efficiency result which lead to errors in judgment. This may be reflected in a reduced quality of work and an increased number of accidents.

As you can see, control of exposure to noise is necessary.

ANSWERS TO QUESTIONS:

38. b. Two hours

39. b. Permanent

Not only is noise harmful, it also is annoying. Some of the following basics of sound may be considered more annoying than others:

- Loudness—the more intense or louder a sound is, the more annoying;
- Pitch—a high pitched sound is more annoying than a low pitched sound of equal loudness;
- Irregularity—a sound that occurs at irregular intervals can be more annoying than one that is continuous;
- Localization—a sound that originates from several locations is more annoying than one that originates from a single location.

Remember, a noise doesn't HAVE to be annoying to be a health hazard. Man is sometimes able to adapt to noise, and not realize that his exposure could cause a hearing loss. This is why it is so important to have an expert test your work area for noise level.

TRY TO ELIMINATE THE HAZARD

When excessive noise is present in your work area, you should try eliminating the hazard.

WAYS TO ELIMINATE OR SEGREGATE NOISE HAZARDS

40. There are several methods you can use to eliminate or segregate employees from noise hazards. They are:

    a. Machine insulation.

    b. Control of noise by sound absorption material on the walls of a work area.

    c. Substitution of less noisy machines.

    d. Reduction of the exposure time an employee spends near a noise hazard.

    e. Use of personal protective equipment.

Which of these five control procedures is the one you should try last?

THERE IS USUALLY MORE THAN ONE SOURCE OF NOISE

Usually there is more than one source of noise in any work area. The effect of many noises is called "mixed exposure." The OSHA standard explains how to determine the duration per day employees can be exposed before a hearing loss will result. The standard on "mixed exposure" states:

ANSWERS TO QUESTIONS:

40. e. Use of personal protective equipment. You should first try to eliminate the noise from your work area.

"When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each . . . ." 1910.95(b) (3), *FEDERAL REGISTER*, Page 22158.

IMPROPER LIGHTING IS A HEALTH HAZARD

Another type of health hazard is improper ILLUMINATION (lighting).

Many accidents are caused by inadequate illumination (employees not being able to see what they are doing). Although there are no OSHA illumination standards at this time, the following section includes suggested good practices in this area.

EYES WORK HARDER WHEN CONTRAST IS POOR

The apparent difference between an object and its surroundings has a marked effect on vision. When contrast is poor (improper lighting), eyes have to work harder, and it takes longer to see things clearly. With proper lighting, objects stand out from the surrounding background and are easier to see.

Each work area has its own particular lighting needs.

Good illumination should be provided in all walking, working and service areas and for all difficult seeing tasks.

There also should be sufficient illumination in all working places.

Good lighting reduces eye strain and fatigue. Fatigue among employees makes accidents more likely to occur.

Poor lighting is one of the easier health problems to detect. One of the most immediate actions for you to take would be to have bulbs installed that have adequate wattage. Your next step would be to see whether additional lighting should be added.

You need to ask yourself whether you and those you supervise have a hard time performing your tasks because you can't see what you are doing. Many jobs require good light—for example, assembly line operations.

When lighting is poor in a work area, employees will develop poor eyesight and the quality and quantity of production will decrease as well.

Another environmental concern, not specifically covered by the OSHA standards, is the effect of temperature extremes on the body. The following information represents suggested good practices.

TEMPERATURE EXTREMES ARE HEALTH HAZARDS, that may affect persons. The body tends to adapt itself to its environment by such processes as blood circulation, sweating, and change of metabolic rate. In a cold environment, the blood circulation at the skin surface is reduced and metabolism is increased by shivering. In a warm environment, blood circulation is increased and sweating occurs.

This type of exposure is both internal and external.

TEMPERATURE EXTREMES CAN BE FATAL

Very high or low temperatures can be endured for a short time, but long exposure is harmful. Low temperatures can destroy tissues of the fingers, toes, nose, or ears. High temperatures can cause fatal elevation of the body temperature. Some operations that involve extreme temperatures cannot be eliminated; therefore protective equipment should be supplied to employees involved.

PHYSICAL EXAMS ARE ESSENTIAL

All employees who work in temperature extremes should receive physical examinations prior to being assigned to such tasks. A doctor can advise persons as to replacing lost body fluids and salts. People with heart trouble or circulatory problems should also be cleared by a doctor before they are assigned to this type of work.

All of the following are effects of working in temperature extremes:

- Sweating;
- Damage to finger tissue;
- Elevation of the body temperature;
- Heart strain;
- Damage to nose tissues.

CONTROL FOR TEMPERATURE EXTREMES

Since many temperature extreme problems can't be controlled, it is best to check with a personal protective equipment manufacturer to learn what types of equipment are available for the types of extremes employees must work under.

THE EFFECT OF RADIATION ON THE HUMAN BODY

Another type of health hazard is IONIZING RADIATION. During its first 22 years of existence, the Atomic Energy Commission compiled a safety record for radiation exposure about 25 times better than its record for injuries from falls.

The low incidence of fatalities from radiation is due to the constant control of this hazard.

KNOW THE STANDARDS

We are all exposed to radiation in our daily lives. Man has been able to tolerate this low level of radiation. Since protection is so important, standards are very exact in the types of protection we should use. These standards can also be found in the *FEDERAL REGISTER.*

PROCEDURES TO CONTROL FOR HAZARDS

Control steps are extremely important for radiation hazards.

The procedures for controlling other hazards are the same for radiation hazards:

- Elimination;
- Segregation;
- Personal protective equipment.

The OSHA standards cover many facets of radiation such as:

- Exposure of individuals to radiation in restricted areas;
- Exposure to airborne radioactive material;
- Precautionary procedures and personal monitoring;
- Caution signs, labels, and signals;
- Immediate evacuation warning signal;
- Storage of radioactive materials;
- Waste disposal.

The control procedures are critical when you realize there is no way to tell that you are being exposed to radiation by any of your sense organs. It cannot be seen, heard, felt, smelled, or tasted.

LONG-TERM RADIATION EFFECTS

There are several long-term effects brought about by exposure to radiation. These are:

- Tumors
- Fetal injury (damage to unborn children during pregnancy)
- Sterility
- Leukemia
- Shortened life span

- Cataracts of the eyes
- Mutations in offspring (genetic effect)
- Bone damage
- Anemia

Exposure to radiation, therefore, can be termed external, internal, or both, depending on the type and duration of exposure.

In radiation exposure, there is usually a "latent period." This means there is a time lapse between the time exposure occurred and the time the effects become known.

It is best to see a doctor at once if you become exposed to radiation. Do NOT wait for the symptoms.

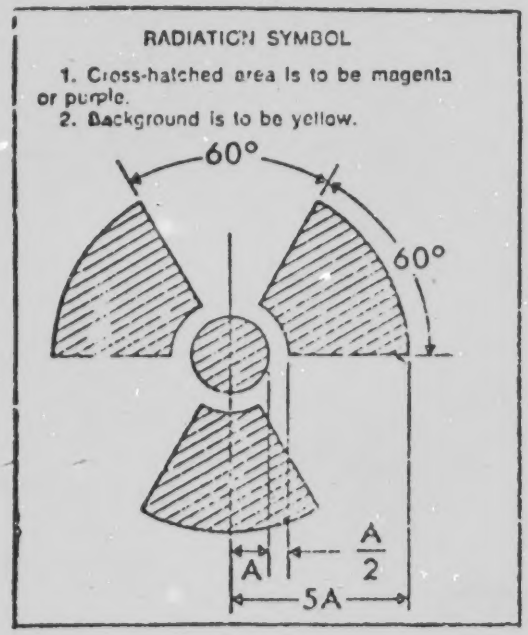
REQUIRED WARNING SIGNS

The standards require many procedures be followed. One is to post radiation signs to warn employees of the presence of the radiation hazard. An example of this type of sign can be found below.

PERSONAL MONITORING IS IMPORTANT

One of the best precautionary measures is personal monitoring of radiation. The standards state:

> Every employer shall supply appropriate personnel monitoring equipment such as film badges, pocket chambers, pocket dosimeters, or film rings, to, and shall require the use of such equipment by each employee who . . . . 1910.96(d) (2)



These devices measure the amount or type of radiation to which the wearer has been exposed. They do not protect workers from radiation hazards. The devices merely indicate the amount of exposure an employee receives.

CONSULT WITH AN EXPERT

Radiation protection is a highly specialized field. We have attempted here to give you a basic understanding of the effects of radiation exposure on employees.

The following items pertain to the information found in this lesson. If you have trouble answering the questions, review the lesson items that pertain to them.

REVIEW QUESTIONS

41. What are the three basic ways by which toxic materials enter the body?

    a. _____

    b. _____

    c. _____

42. In your own words, what is one of the best ways to control for toxic materials?

    _____

    _____

43. Health hazards result from two types of exposure to toxic materials. What are they?

    a. _____

    b. _____

44. Give the name of the value (and its abbreviation) that refers to the concentrations of airborne substances that nearly all employees may be safely exposed to for 8-hour days, for 40-hour workweeks, for the extent of their normal working life?

45. Exposures above the TLV are not permitted when a _____ limit has been established.

46. If you can't see the airborne contaminants, they aren't there.

    a. True

    b. False

ANSWERS TO QUESTIONS:

41. a. Absorbing them through the skin
    b. Breathing them or inhaling them into the respiratory track
    c. Swallowing them into the digestive tract

42. One of the best ways to control for toxic materials is to install proper ventilation systems.

43. a. Internal b. External

44. Threshold Limit Value (TLV)

45. Ceiling

46. b. False

Match each classification of hazardous material (on the left) with its description (on the right):

47. Irritant materials _____ a. Combine with the blood and prevent normal transfer of oxygen from the blood to the tissues

48 Asphyxiant materials _____ b. Damage the lungs by corrosive action or by interfering with normal breathing action

49. Anesthetic and narcotic materials _____ c. Cause sleepiness and nausea

50. Systemic poisons _____ d. Attach vital body organs or systems

51. Name four of the eight basic methods used to control most primary health hazards:

a. _____

b. _____

c. _____

d. _____

ANSWERS TO QUESTIONS:

47. b.

48. a.

49. c.

50. d.

51. Any four of these:

    a. Substitution of less toxic materials
    b. Enclosure of harmful processes
    c. Isolation of harmful processes
    d. Local exhaust ventilation
    e. General ventilation
    f. Use of wet method
    g. Use of personal protective equipment
    h. Decreased daily exposure for employee

---

52. Who do you feel should select special protective equipment such as respirators?

    a. You

    b. An industrial hygienist

53. Who is basically responsible for seeing that employees wear required protective equipment?

    a. You

    b. The industrial hygienist

54. Occupational contact dermatitis is an inflammation of the _____.

55. Noise affects only the ears and hearing mechanism.

    a. True

    b. False

56. The last alternative to be used to control for noise is _____ _____ equipment.

ANSWERS TO QUESTIONS:

52. b. An industrial hygienist. He is the one most qualified to determine the best equipment to use.

53. a. You

54. Skin

55. False. Noise also affects the heart, kidneys, and blood vessels.

56. Personal protective

---

57. It is best to avoid all unnecessary exposure to radiation.

    a. True

    b. False

58. You usually know when radiation is present because you either see, hear, taste, smell, or feel it.

    a. True

    b. False

59. Personal monitoring devices for radiation are excellent as protective equipment.

    a. True

    b. False

REVIEW

Front-line supervisors should be actively involved in all of the following:

- Learning about legal requirements for occupational safety and health;
- Making employees aware of work hazards, their potential effects, and precautionary measures;
- Teaching employees safe work habits;
- Seeing that employees use required protective equipment properly;
- Requesting needed advice and assistance from technically trained safety and health personnel;
- Helping to live up to the law in providing employees ". . . employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm . . . ."

ANSWERS TO QUESTIONS:

57. a. True

58. b. False

59. b. False. They do not protect; they simply give an indication of exposure levels.

LESSON 9

BASIC PERSONAL PROTECTIVE EQUIPMENT AND ITS USE

The purpose of this lesson is to discuss the basic types of personal protective equipment, their use, how they relate to the Act, and suggestions on how to have an effective personal protective equipment program.

The OSHA standards describe ways to eliminate many of the hazards or hazardous conditions that exist in industry. However, in many cases it is impractical to eliminate these hazardous conditions, so emphasis must be on other ways to CONTROL hazards. In many of the preceding lessons, we have discussed three ways to control hazards.

1. What are these control procedures?

   a. _____

   b. _____

   c. _____

REQUIREMENTS IN THE OSHA STANDARDS

This lesson deals with ways to protect employees from hazards that cannot be eliminated from the work environment. An important method that can be adopted to protect workers from hazards is the use of personal protective equipment. The law says the following about the general requirements for personal protective equipment (CFR 1910 Subpart 1):

"(a) Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

"(b) Employee-owned equipment. Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

"(c) Design. All personal protective equipment shall be of safe design and construction for the work to be performed."

PROTECTION OF EMPLOYEES IS IMPORTANT

Since the Act requires all employers to provide safe and healthful workplaces, employers are required to use any means available to achieve this goal. The use of personal protective equipment is mandatory when you can't eliminate or segregate a hazard.

2. Does the employer have to provide maintenance on protective equipment that the employee owns and uses at work?

   a. yes

   b. no

ANSWERS TO QUESTIONS:

1. a. elimination of the hazard

   b. segregation of the hazard

   c. protection from the hazard

2. a. Yes. This is a requirement that is stated in the standards.

The previous information from the law on DESIGN indicates some protective equipment might not be safe for the work to be performed. It is advisable to exercise care in choosing the equipment to match the type of hazard employees will be working under. If you are trying to choose a respirator that will filter out dust, remember that different respirators will be needed, depending upon the type and concentration of dust that is in your work area.

SPECIFIC REQUIREMENTS

The standards cover many different types of personal protective equipment, such as:

- eye and face protection
- respiratory protection
- head protection
- foot protection
- electrical protection

THE PROPER EQUIPMENT IS IMPORTANT

It is important to remember that one respirator will not protect employees from all hazards. For example, there are many types of respirators and respirator cartridges, but certain conditions require a respirator with a specific cartridge—and any other cartridge may be useless. A cartridge designed to filter out chlorine does no good if the contaminant is ammonia. A respirator designed to filter out ammonia is useless, even if the contaminant is ammonia, under conditions where the atmosphere is deficient in oxygen, or if the percentage of ammonia exceeds the limits of the respirator cartridge. Also, an employee wearing the proper type of respirator and cartridge may still be using one that is ineffective and unsafe because the respirator cartridge needs to be replaced.

3. Does the use of protective equipment eliminate the hazard from your work area?

   a. yes

   b. no.

4. Elimination or segregation of a specific hazard should be your first attempt to _____ the hazard.

ANSWERS TO QUESTIONS:

3. No. Protective equipment only protects the wearer and does not rid the work area of a hazard; the hazard still remains.

4. Control

Before going into a description of the many types of equipment available, one point should be made clear. To buy protective equipment is not enough. You will need to continually educate your employees so that they understand why the equipment is necessary. This is another example of why you are so important to your company. If you don't educate those you supervise, they will not understand why personal protective equipment is important.

Now let's look again at the five categories covered by the standards:

- eye and face protection
- respiratory protection
- head protection
- foot protection
- electrical protection

Each of these categories will be covered in this lesson.

EYE AND FACE PROTECTION

The first category under protective equipment is EYE AND FACE PROTECTION. This is required where there is a reasonable probability that an injury can be prevented by such equipment. It is required that not only employees performing operations such as grinding and sandblasting wear protective equipment, but also people who are near the operations, including other employees, supervisors, and visitors.

REQUIREMENTS FOR EYE AND FACE PROTECTORS

The standards require the use of suitable eye and face protection. Minimum requirements for protectors are specified in the OSHA standard (1910.133(a) (2).) These requirements state that:

"1. They shall provide adequate protection against the particular hazards for which they are designed.

2. They shall be reasonably comfortable when worn under the designated conditions.

3. They shall fit snugly and shall not unduly interfere with the movements of the wearer.

4. They shall be durable.

5. They shall be capable of being disinfected.

6. They shall be easily cleanable.

7. Protectors should be kept clean and in good repair."

As you can see by these requirements, the law is interested in the adequate protection and comfort of employees, design to allow for easy cleaning, and the need to repair such equipment. All of these requirements are concerned mainly with the protection of employees from hazards.

CORRECTIVE LENSES

The standards are specific about the type of protection to be used. One group of standards specifies the types of eye protection to use for employees who wear corrective lenses (glasses):

"Persons whose vision requires the use of corrective lenses in spectacles, and who are required by this standard to wear eye protection, shall wear goggles or spectacles of one of the following types;

1. Spectacles whose protective lenses provide optical correction;

2. Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles;,

3. Goggles that incorporate corrective lenses mounted behind the protective lenses."

5. An employee, who wears his own corrective lenses, was sandblasting without the use of the protective equipment he was issued. Is this a violation of a standard under the Occupational Safety and Health Act?

   a. Yes

   b. No

6. The _____ could be issued a citation for this type of violation.

   a. employer

   b. employee

ADDITIONAL REQUIREMENTS

The section of the standards (1910.133(a) (4-6).) closes with these requirements:

"4. Every protector shall be distinctly marked to facilitate identification only of the manufacturer.

"5. When limitations or precautions are indicated by the manufacturer, they shall be transmitted to the user and care taken to see that such limitations and precautions are strictly observed.

6. Design, construction, testing and use of devices for eye and face protection shall be in accordance with American National Standard for Occupational and Educational Eye and Face Protection, Z87, 1 - 1968."

ANSWERS TO QUESTIONS:

5. a. Yes

6. a. Employer. Since the law holds the employer responsible for all violations. You, as the representative of your employer, must make it your business to be sure employees use their protective equipment.

ANSI Standard Z87 gives specifications for design as well as functional requirements of eye and face protective equipment. A simple guide to determine whether the lenses conform to the standards is to see if the manufacturer's monogram (trademark) is on the lens. If the manufacturer's monogram is on the lens, then the lenses conform to the standards. If your work area requires the use of this equipment, you should have a copy of these standards.

EDUCATION IS IMPORTANT

It is important that the proper face and eye protection equipment be selected and used correctly. You should educate employees in the proper use of this equipment. Being a supervisor, you are in the best position to do so.

Turn to the Selection Chart on the next page. It will help you determine what type of equipment to choose. Each protector is numbered with the name of each type. Below the names of the protectors is a table called "Applications." The table is divided into three parts. These parts are:

- Operation—type of work performed.
- Hazards—the types of hazards found in each operation.
- Recommended Protectors—the equipment, by number, that will protect the employee from the hazards.

Study this chart carefully. Then turn to the questions on the information found in this chart or the page following the chart.

RECOMMENDED PROTECTORS

7. What are the recommended protectors, by number, for acetylene burning, cutting, or welding?

   a. _____

   b. _____

   c. _____

8. What protection is advisable for electric (arc) welding?

   _____

9. If, in your work area, you are concerned with protection from severe exposure to chemical splash, what protector is most preferred?

   _____

Table E–1—Eye and Face Protector Selection Guide

1. GOGGLES, Flexible Fitting, Regular Ventilation
2. GOGGLES, Flexible Fitting, Hooded Ventilation
3. GOGGLES, Cushioned Fitting, Rigid Body
*4. SPECTACLES, Metal Frame, with Sideshields
*5. SPECTACLES, Plastic Frame, with Sideshields
*6. SPECTACLES, Metal-Plastic Frame, with Sideshields
** 7. WELDING GOGGLES, Eyecup Type, Tinted Lenses (Illustrated)
7A. CHIPPING GOGGLES, Eyecup Type, Clear Safety Lenses (Not Illustrated)
** 8. WELDING GOGGLES, Coverspec Type Tinted Lenses (Illustrated)
8A. CHIPPING GOGGLES, Coverspec Type, Clear Safety Lenses (Not Illustrated)
** 9. WELDING GOGGLES, Coverspec Type, Tinted Plate Lens
10. FACE SHIELD (Available with Plastic or Mesh Window)
**11. WELDING HELMETS

APPLICATIONS		
OPERATION	HAZARDS	RECOMMENDED PROTECTORS: Bold Type Numbers Signify Preferred Protection
ACETYLENE-BURNING ACETYLENE-CUTTING ACETYLENE-WELDING	SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES	**7, 8, 9**
CHEMICAL HANDLING	SPLASH, ACID BURNS, FUMES	**2, 10** (For severe exposure add 10 over 2)
CHIPPING	FLYING PARTICLES	**1, 3, 4, 5, 6, 7A, 8A**
ELECTRIC (ARC) WELDING	SPARKS, INTENSE RAYS, MOLTEN METAL	**9, 11** (11 in combination with 4, 5, 6, in tinted lenses, advisable)
FURNACE OPERATIONS	GLARE, HEAT, MOLTEN METAL	**7, 8, 9** (For severe exposure add 10)
GRINDING-LIGHT	FLYING PARTICLES	**1, 3, 4, 5, 6, 10**
GRINDING-HEAVY	FLYING PARTICLES	**1, 3, 7A, 8A** (For severe exposure add 10)
LABORATORY	CHEMICAL SPLASH, GLASS BREAKAGE	**2** (10 when in combination with 4, 5, 6)
MACHINING	FLYING PARTICLES	**1, 3, 4, 5, 6, 10**
MOLTEN METALS	HEAT, GLARE, SPARKS, SPLASH	**7, 8** (10 in combination with 4, 5, 6, in tinted lenses)
SPOT WELDING	FLYING PARTICLES, SPARKS	**1, 3, 4, 5, 6, 10**

*Non-side shield spectacles are available for limited hazard use requiring only frontal protection.

**See Table E–2, in paragraph (b) of this section, Filter Lens Shade Numbers for Protection Against Radiant Energy.

ANSWERS TO QUESTIONS:

7. a. 7. Welding goggles—eye cup type.
   b. 8. Welding goggles—coverspec type, tinted lenses
   c. 9. Welding goggles—coverspec type, tinted plate lenses

8. 11, plus 4, 5 or 6.

9. 2. Goggles, plus 10. face shield

RESPIRATOR PROTECTION

The second classification in the standards for personal protective equipment is called RESPIRATOR PROTECTION. As stated earlier in this lesson, there are different types of respirators for different operations because each hazard is different and necessitates a specific type of equipment to protect employees.

The standards require respiratory protection for the control of occupational health hazards caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors that cannot otherwise be kept from contact with employees or visitors.

10. As stated before, your last resort in the control of hazards is to provide personal _____ _____ for your employees.

11. Does providing protective equipment eliminate a hazard?

    a. Yes

    b. No

Here are the MINIMUM requirements (1910-134(b) (1-11)) for an acceptable program of respiratory protection. Read these requirements carefully.

Following items will refer to these standards:

"1. Written standard operating procedures governing the selection and use of respirators shall be established.

2. Respirators shall be selected on the basis of hazards to which the worker is exposed.

3. The user shall be instructed and trained in the proper use of respirators and their limitations.

4. Where practicable, the respirators should be assigned to individual workers for their exclusive use.

5. Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often, if necessary. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use.

6. Respirators shall be stored in a convenient, clean, and sanitary location.

ANSWERS TO QUESTIONS:

10. Protective equipment

11. b. No. The equipment only protects the person who is wearing it. The hazard still remains.

"7. Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use.

8. Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

9. There shall be regular inspections and evaluations to determine the continued effectiveness of the program.

10. Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician should determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

11. Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities. The U.S. Department of Interior, Bureau of Mines, and the U.S. Department of Agriculture are recognized as such authorities. Although respirators listed by the U.S. Department of Agriculture continue to be acceptable for protection against specified pesticides, the U.S. Department of the Interior, Bureau of Mines, is the agency now responsible for testing and approving pesticide respirators."

MINIMUM REQUIREMENTS

The standards that you have just read are the minimum requirements for respiratory protection. This means that you can't legally provide less protection for employees, but you can do more. It is good practice to do as much as you can, not just do what the law compels you to do.

In addition to providing protective equipment, certain OSHA Standards also require that records be maintained for each employee exposed to toxic material. The employee has the right to see these records.

See if you can recall the answer to the following question:

12. Can a respirator designed to filter chlorine gas be useful when working with ammonia gas?

There are three major classifications of respirators which we will now discuss:

- air purifying respirators
- supplied air respirators
- self-contained breathing devices

ANSWERS TO QUESTIONS:

12. No. You have to be careful to match the kind of respirator you are using to the kind of hazards you are exposed to. (Refer to the paragraph on "The Proper Equipment Is Important" at the beginning of this lesson.)

Selection of respirators shall be made according to the guidance of the American National Standard Practices for Respiratory Protection Z88.2--1969. Some respirators are used to purify the air from contaminants (air purifying respirators), while others are used to supply fresh air to the employee (supplied-air respirators). The type of respirator those you supervise would need to use if they went into a room that had hydrogen sulfide gas and insufficient oxygen is a supplied-air respirator, since the employees need to have a supply of air to survive in a room which is largely full of hydrogen sulfide gas.

13. If your employees were to work in a room that had a moderate concentration of dust and a sufficient supply of oxygen, what type of respirator would you suggest using?

14. Now, suppose your employees had to work in a room that had an extremely heavy concentration of dust. What kind of respirator would be best for them?

SUPPLIED-AIR RESPIRATORS

Whenever your employees work in areas where they need to use supplied-air respirators, you must develop special safety precautions. The standards require that additional men be present in case the respirator malfunctions and rescue is needed. These precautions point out that respirators need to be checked continually to see they are operating properly.

SELECTION OF A RESPIRATOR

Selecting a respirator involves many factors such as the nature of the process, the nature of the air contaminant, its concentration, and the contaminant's effect on the body.

When selecting a respirator, you should consider the specific functional and physical characteristics of the particular respiratory protective device. The labels on the respirators are good sources of information. A sample of the U.S. Bureau of Mines and National Institute for Occupational Safety and Health (NIOSH) approval label, which must appear on the device, is shown on the following page.

The label must contain the type of respirator, schedule and serial number of approval, and the name and address of the applicant. The label also must contain a list of assembly or part numbers which describe a complete approved system. These numbers are permanently marked on the part or assembly.

The label also describes the limitations of usage of the respirator and the cautions to be exercised when using the respirator. The text reads as follows:

> "This respirator shall be selected, fitted, used and maintained in accordance with Bureau of Mines, Occupational Safety and Health Administration, and other applicable regulations."

Type of Respirator

PERMISSIBLE

FOR ORGANIC VAPORS

BUREAU OF MINES AND NATIONAL INSTITUTE
FOR OCCUPATIONAL SAFETY AND HEALTH

Schedule and Serial Number of Approval

APPROVAL NO.

Prefix (TC); followed by Schedule Identification (13F, 14G, 19C, 21C, 23C); and Specific Respirator Number.

ISSUED TO

Name and Address of Applicant

Company and Address

The approved assembly consists of list of assembly or part numbers which describe a complete approved system. These numbers are permanently marked on the part or assembly.

LIMITATIONS

Text - limitations of usage of the respirator.

CAUTION

Text - cautions to be exercised when using the respirator. This respirator shall be selected, fitted, used, and maintained in accordance with Bureau of Mines, Occupational Safety and Health Administration, and other applicable regulations.

H-_____-P

ANSWERS TO QUESTIONS:

13. Air purifying respirator

14. Supplied-air. The air purifying respirator would probably not be able to keep up with the load imposed on it.

LABELING IS IMPORTANT

15. Would you use a respirator having this label for protection from dusts?

    a. Yes

    b. No

16. In addition to the type of respirator, schedule and serial no. of approval, name and address of applicant, and list of assembly or part numbers, the label also must contain the following:

    a. _____

    b. _____

We will discuss each classification of protective device in the following paragraphs.

- Air purifying respirators

  –gas masks
  –chemical cartridge respirators
  –particulate filter respirators
  –combination chemical and mechanical filter respirators

- Supplied-air respirators

  –hose masks
  –air line respirators
  –abrasive blasting respirators
  –air supplied hoods
  –air supplied suit

- Self-contained breathing devices

  –recirculation apparatus (oxygen generating)
  –recirculating apparatus (oxygen cylinder)
  –open circuit apparatus

ANSWERS TO QUESTIONS:

15. No. The label must state specifically what type of protection the respirator is designed for. (For example: "PERMISSIBLE FOR DUSTS," or "PERMISSIBLE FOR ORGANIC VAPORS")

16. a. Limitations of usage.

    b. Cautions to be exercised when using.

AIR PURIFYING RESPIRATORS

GAS MASKS

Let's take a look at each of these three categories. The first category is AIR PURIFYING RESPIRATORS. Under this classification you will find gas masks. Gas masks are face masks connected by a flexible tube to a canister which is intended to remove a certain type of gaseous contaminant or some airborne particles. They can be used only in atmospheres that contain sufficient oxygen to support life (16% minimum).

17. Does an air purifying respirator give its wearer additional oxygen?

    a. Yes

    b. No

18. The value of 16% oxygen may seem quite small, but even our normal atmosphere contains only 20% oxygen with a mixture of other elements (such as nitrogen). Since there is no oxygen on the moon, would a gas mask be helpful to the astronauts who walked on the moon?

    a. Yes

    b. No

LABELING AND COLOR CODING IS REQUIRED

The standards require the canisters of gas masks to be labeled and color coded according to the specific type of contaminant they protect against. Look at some examples of color coding that are required for gas masks on the following chart. Mark any of the toxic materials that might be present in your work ares, then memorize the color code with which the canister would be painted.

ANSWERS TO QUESTIONS:

17. b. No. There are no air hoses attached to give additional oxygen.

18. b. No. Since there is no oxygen on the moon, and gas masks only filter contaminants from the air, the gas mask would not be useful. Gas masks can only be used where there is enough oxygen in the air—at least 16% oxygen.

EXAMPLES OF GAS MASK CANISTER COLOR CODING

Acid gases	White
Hydrocyanic acid gas	White with 1/2-inch green stripe around the canister near the bottom
Chlorine gas	White with 1/2-inch yellow stripe around the canister
Organic vapors	Black
Ammonia gas	Green
Acid gases and ammonia gas	Green with 1/2-inch white stripe completely around the canister near the bottom
Carbon monoxide	Blue
Acid gases and organic vapors	Yellow
All of the above atmospheric contaminants (dust, fumes, mists, fog, or smoke)	Red with 1/2-inch gray stripe completely around the canister near the top

Orange shall be used as a complete body, or stripe color, to represent gases not included above.

19. Using the same color coding chart, find the colors for the two examples of labels for the respiratory equipment a few pages back.

    - Label #1 was "Permissible for Dusts."
    - Label #2 was "Permissible for Organic Vapors."

    a. The color code for Label #1 is_____ .

    b. The color code for Label #2 is _____ .

20. What is the minimum percentage of oxygen content in the atmosphere where oxygen masks may be used?

ANSWERS TO QUESTIONS:

19. a. Label #1 canister would be red with 1/2-inch gray stripe completely around the canister near the top.

    b. Label #2 canister color would be black.

20. 16%

CHEMICAL CARTRIDGE RESPIRATORS

Another type of respirator under the classification of air purifying respirators is the CHEMICAL CARTRIDGE RESPIRATOR. This type of respirator is used for dusts, fumes, or mists in COMBINATION with organic vapors. The color of the canister of the chemical cartridge respirator, like the gas mask canisters, will change depending on the airborne contaminant employees are exposed to.

PARTICULATE FILTER RESPIRATORS

Another group of air purifying respirators is called PARTICULATE FILTER RESPIRATORS. These are mechanical respirators that remove airborne particles of various sizes. The smaller the particle to be filtered, the less porous the filter, causing a greater resistance to breathing. Therefore, the chief problem is that breathing is hard, which can be tiring to the employee.

21. Would dust be considered an airborne particle?

    a. Yes

    b. No

THE COMBINATION RESPIRATOR

The last type of AIR PURIFYING RESPIRATOR that we will discuss is called a COMBINATION RESPIRATOR. This type of respirator combines a mechanical filter with a chemical cartridge. A respirator of this type is important because it protects employees from more than one hazard that may be found in a work area. For example, the filter would protect the employee from a hazard such as dust particles while the chemical cartridge would protect the employee from another health hazard such as fumes. This protects the employee from dual or multiple exposure. One important point to keep in mind about filters and cartridges is that they don't last indefinitely. Once exhausted, they must be changed. An important duty for you or the employee is to keep a constant check on the filters or cartridges and have them changed when necessary by experienced personnel.

22. What are the four types of air purifying respirators?

    a. _____

    b. _____

ANSWERS TO QUESTIONS:

21. a. Yes

c. _____

d. _____

ANOTHER CLASSIFICATION OF RESPIRATORS

The second major classification of respirators is called SUPPLIED AIR RESPIRATORS.

If your employees had to use a respirator in an area that didn't have enough oxygen, they would use a supplied air respirator. The AIR PURIFYING RESPIRATOR is only useful when you can be sure there is enough oxygen getting through the respirator. As previously stated, 16% oxygen in the atmosphere is the minimum for using the air purifying respirator. Oxygen content below that level will require the use of the supplied air respirator.

Supplied-air respirators are also used when there is a very high concentration of a toxic substance in the air.

One type of supplied-air respirator is called a HOSE MASK. "Hose" masks are simply masks that fit over the face and have a pressure hose for air. Air is usually supplied by a power-driven blower from an independent source which is known to be uncontaminated. It is important to regularly inspect the hose for leaks or wear and tear. The maximum length of hose approved by the U.S. Bureau of Mines is 300 feet. This means that an employee does not have complete freedom of movement using a hose mask.

The standards require that "in areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional man shall be present. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of emergency." As with any new type of equipment, it is important for you to train your employees in the use and care of the respirators with which they deal.

AIR LINE RESPIRATORS

Another supplied-air respirator is called an AIR LINE RESPIRATOR. The air line respirator is different from the hose mask since it uses a compressed air line from either a cylinder or a compressor for its oxygen supply instead of a power-driven blower that is used for the hose masks.

OTHER TYPES OF SUPPLIED-AIR RESPIRATORS

There are three other types of supplied-air respirators. All use compressed air for their oxygen supply. These other respirators are:

- Abrasive blasting respirator—used for protection against high speed abrasive particles from such operations as sandblasting and grinding. The eye pieces are made of safety glass or plastic covered by a metal screen.

ANSWERS TO QUESTIONS:

22. a. Gas masks
    b. Chemical cartridge respirator
    c. Particulate filter respirator
    d. Combination respirator

- Air-supplied hoods—used for long-term operations in hot, dusty situations.
- Air-supplied suits—used where the contaminant may be corrosive to the skin.

23. Supplied-air respirators have hoses attached to the air supplies. The law requires that the length of the hose be no more than:

    a. 100 feet

    b. 200 feet

    c. 300 feet

24. Since the oxygen supply for supplied-air respirators comes from a distant source (up to 300 feet away), what safety precaution is required by law?

    a. An extra respirator available for the employee

    b. A helper if rescue is needed

25. What are the two main classifications of respirators you have read about so far?

    a. _____

    b. _____

SELF-CONTAINED BREATHING DEVICES

The last major classification of respirators is called SELF-CONTAINED BREATHING DEVICES. When it is necessary for an employee to work in a hazardous atmosphere without being hampered by long hoses, the self-contained breathing devices are used.

There are two main classes of self-contained breathing devices. The first type is called a CLOSED CIRCUIT DEVICE. The most efficient type of closed circuit (recirculating) device uses compressed air. The wearer breathes oxygen from an air tank on his back. When the user exhales, the exhaled breath is directed to a reservoir breathing bag and is purified of the carbon dioxide by a chemical cartridge. The remaining oxygen can then be rebreathed. This presents the most efficient use of the oxygen.

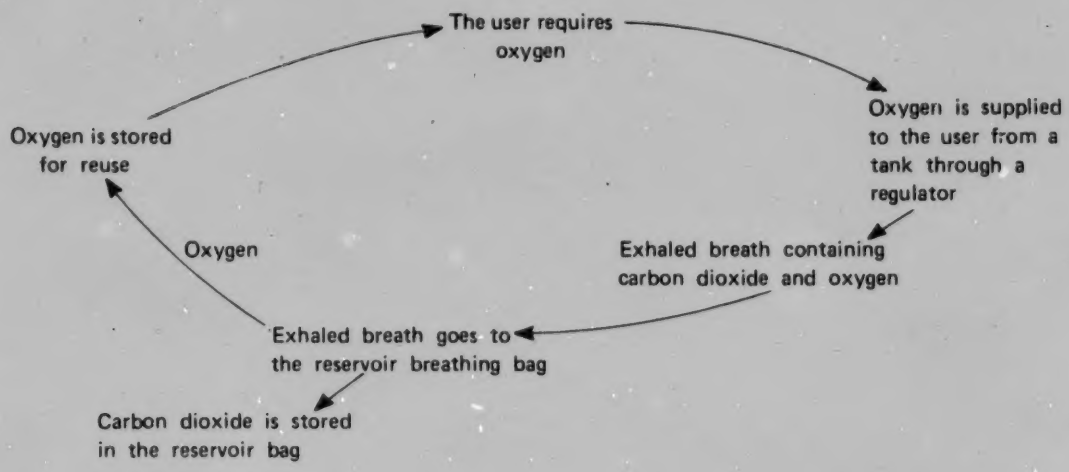
ANSWERS TO QUESTIONS:

23. c. 300 feet. If the employee gets too far from his air source, the chances of his surviving a loss of air is minimal. Also, a hose length over 300 feet requires more air pressure than the normal air compressor can generate; therefore, the employee wouldn't get enough oxygen to work under.

24. b. A helper if rescue is needed

25. a. air purifying respirators b. supplied-air respirators

Below is a diagram of how the closed circuit design works:


The user requires oxygen
Oxygen is supplied to the user from a tank through a regulator
Exhaled breath containing carbon dioxide and oxygen
Exhaled breath goes to the reservoir breathing bag
Carbon dioxide is stored in the reservoir bag
Oxygen
Oxygen is stored for reuse

NO OXYGEN ESCAPES

26. From the information given to you in the diagram, does any oxygen escape into the atmosphere?

a. Yes

b. No

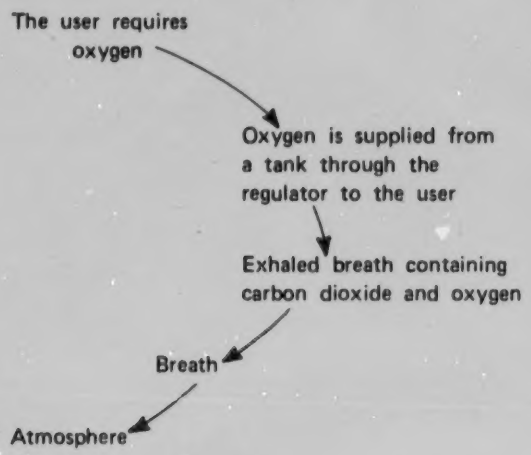
ANSWERS TO QUESTIONS:

26. b. No. It is stored for reuse. This is important because sometimes this unit is used in places where it would be dangerous or undesirable to add oxygen to the atmosphere. One important point to remember is that the closed circuit design does not provide oxygen indefinitely. Eventually, the oxygen is used up and the closed circuit device needs to be recharged. The chemical cartridge will also need to be changed when it no longer extracts the carbon dioxide.

THE OPEN CIRCUIT DEVICE

A second type of self-contained breathing device is called an OPEN CIRCUIT DEVICE. This device uses a cylinder of compressed air that can be carried, a demand regulator, and a mask and tube assembly with an exhalation valve. This type of device is quite similar to the kind of gear used by sport skin divers.

Below is a diagram of an open-air device:


The user requires oxygen
Oxygen is supplied from a tank through the regulator to the user
Exhaled breath containing carbon dioxide and oxygen
Breath
Atmosphere

27. The open circuit device is different from the closed circuit device in that the _____ is not recirculated.

Selection of the proper respiratory equipment is made in accordance with American National Standard Practices for Respiratory Protection Z88.2–1969. Technical assistance from qualified personnel may be required to make such selection, depending on the hazard to which employees are exposed.

ANSWERS TO QUESTIONS:

27. Oxygen/air. Open circuit respirators are usually lighter, cheaper, and less complicated than closed circuit models, but they cannot be used in certain locations.

TRAINING IS IMPORTANT

One of the most important factors (regarding all types of respirators) is effective training on proper use and limitations of the equipment.

Standards cover this also (1910.134(e)(5).)

> "For safe use of any respirator, it is essential that the user be properly instructed in its selection, use and maintenance. Both supervisors and workers shall be so instructed by competent persons. Training shall provide the men an opportunity to handle the respirator, have it fitted properly, test its face-to-face seal, wear it in normal air for a long familiarity period, and, finally, to wear it in a test atmosphere . . . . Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly."

All of the above requirements are important to insure the safety and health of employees. This instruction must be accomplished to be in compliance with the standard.

HEAD PROTECTION

Another type of personal protective equipment covered in the standards is OCCUPATIONAL HEAD PROTECTION. The standard reads as follows (1910.135):

> "Helmets for the protection of heads of occupational workers from impact and penetration from falling and flying objects and from limited electric shock and burn shall meet the requirements and specifications established in American National Standard Safety Requirements for Industrial Head Protection Z89.1–1969."

28. From the information given above, head protectors are designed only to protect employees from hazards of falling and flying objects.

    a. True

    b. False

Within the American National Standard Safety Requirements for Industrial Head Protection, you will find that helmets are classified as:

- Class A–LIMITED VOLTAGE resistance for general service
- Class B–HIGH VOLTAGE resistance
- Class C–NO VOLTAGE protection
- Class D–Limited protection for FIRE FIGHTING

ANSWERS TO QUESTIONS:

28. b. False. They also protect employees from limited shock and burns.

All helmets must contain, on the inside label, the manufacturer's name, American Standard designation, and the class. All helmets must also meet specifications for impact and penetration.

29. Using the information in the last item, what class helmet would an electric company employee use if he were working on a high-voltage line?

ADDITIONAL REQUIREMENTS FOR HEAD PROTECTION

The following chart shows all of the requirements for head protection. Note that some of these specifications include more than the minimum requirements stated in the standards.

Additional Specifications	Class of Helmet			
	Class A	Class B	Class C	Class D
Water resistant	X	X		
Slow burning	X	X		
No holes in the shell		X		
No metal parts		X		
Fire resistant				X
Nonconductors of electricity		X		X
No additional requirements			X	
Limited voltage resistance for general service	X			
High voltage resistance		X		

30. In your own words, why should there be no metal parts on a Class B helmet?

HELMETS OFFER ADDITIONAL PROTECTION

31. Helmets are designed to protect several parts of the body. Without being given any prior information, try to name a few.

ANSWERS TO QUESTIONS:

29. Class B

30. Because people using Class B helmets work with high voltage equipment and metal is a conductor of electricity.

31. Head, face, back of neck.

When head protection is provided for employees, it is important they be fitted properly. If the protection is not fitted properly, injuries will result. Also, make sure that employees wear their protection constantly when required.

As in the information on the other protectors mentioned, you will need to train your employees in the correct use of their head protectors.

FOOT PROTECTION

Another group of standards covers the use of OCCUPATIONAL FOOT PROTECTION. The following is in 1910.136:

> "Safety toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear Z 41.1–1967."

As in the case of some other standards, safety-toe footwear has been incorporated into the OSHA Standards by reference. It will be necessary for you to get this document if your work area has any hazards that require protective footwear equipment.

FOOT PROTECTION COMES IN MANY FORMS

Safety footwear generally has a metal cap or box built into the toe. The style varies from a heavy boot to a regular dress-type low cut shoe. They may have other built-in features for specific needs such as conductive soles to drain off static charges, shoes with no fasteners for quick removal in the event of splashes of molten metal, reinforced soles to protect from nails or other sharp objects, instep protection, or woodsoled for work in wet areas.

32. When selecting foot protection for an electrician, make sure that there are no parts of_____ _____on the shoe.

Other types of foot protectors include heavy-gauge flanged and corrugated sheet metal guards that can be worn over the regular shoe to protect the employee's toes, feet, and ankles. When deciding what type of protection to use, keep in mind what is the safest for the employee, as well as what is most comfortable.

There are many different designs of foot protectors. Some protect only the toes; others protect the entire foot; still others protect the whole foot and the ankle too. The type you select to use would depend upon the kind of hazards employees face.

33. In your own words, what would reinforced soles or innersoles help protect an employee against?

_____

ANSWERS TO QUESTIONS:

32. Metal. He might step on a wire and be electrocuted.

33. Nails or other sharp objects.

ELECTRICAL PROTECTIVE DEVICES

Another group of protective devices is called ELECTRICAL PROTECTIVE DEVICES. OSHA standards adopt, by reference, the standards for rubber insulating gloves, rubber matting to stand on while working around electrical apparatus, rubber insulating blankets, rubber insulating hoods, rubber insulating line hose, and rubber insulating sleeves. All of these serve as a guide for the selection of equipment to protect employees working around electricity.

34. As you can see from the information in the last item, the type of material that protects employees from electrical injury is _____.

ADDITIONAL PROTECTIVE EQUIPMENT

OSHA lists no standards for other types of personal protective equipment. However, this does not mean you should neglect other personal protective equipment. It is still the employer's duty to provide a safe and healthful working place, free from recognized hazards. Any equipment which can help to protect the employee can help the employer to meet his responsibility. Among the fairly common types of such equipment are:

- Protection against heat and hot metal
- Protection against impact and cuts
- Protection against dusts, vapors and corrosive liquids
- Cold weather clothing
- Special clothing

You can do a variety of things to protect those you supervise against heat and hot metal. You can provide leather clothing (aprons, jackets, leggings, and coats) to protect against heat and splashes of hot metal. Flameproofing compounds are available to make ordinary clothing flame resistant against sparks. For more intense heat, asbestos clothing or clothing with a metallic reflect[illegible] coating would be useful.

Another type of protection is PROTECTION AGAINST IMPACT AND CUTS. Below you will find examples of this type of protection:

- Shoulder or back pads to protect employees carrying heavy loads or objects with rough edges
- Padded aprons to protect the abdomen and chest
- Canvas gloves for light work
- Leather gloves reinforced with metal for rough or abrasive material handling
- Arm guards to protect the arms and wrists from cuts.

ANSWERS TO QUESTIONS:

34. Rubber. Rubber does not conduct electricity.

THE TYPE OF WORK DETERMINES THE TYPE OF PROTECTOR

Clothing to protect employees against dust, vapors, and corrosive liquids is also important. An example would be the coating of clothing with rubber, vinyl or other plastics. The clothing can range from aprons, bibs, and gloves to full garments containing their own air supply. As in the selection of all protective equipment, the type of hazard determines the type of protection to buy.

COLD WEATHER PROTECTION

Cold weather clothing is another type of personal protective equipment. Thermal insulating underwear is a common protection against cold. The principle is lightweight, loose-weave material which creates small air spaces preventing the loss of body heat. There are many other examples of insulated boots, jackets with attached hoods, and other such equipment.

SPECIAL CLOTHING AND PROTECTORS

Although the standards require special clothing under the Asbestos rule (1910.93a), other important types of protection not listed include:

- Clothing treated to reflect light provides high visibility day or night, where employees are exposed to traffic hazards.
- Disposable clothing made of plastic or treated paper is used in some contaminated areas (low radio-active or drug) and provides a safe and economical advantage for the protection of employees.
- Leaded clothing is used by employees exposed to X-ray or gamma radiation.
- Earplugs and earmuffs are used where a sound hazard exists.

35. Which of the following are the six major classifications of personal protection equipment found in the standards and therefore are legally required?

    a. special clothing ____

    b. eye and face protection ____

    c. cold weather clothing ____

    d. respiratory protection ____

    e. occupational head protection ____

    f. protection against heat and hot metal ____

    g. occupational foot protection ____

    h. electrical protective devices ____

ANSWERS TO QUESTIONS:

35. a. special clothing
    b. eye and face protection
    d. respiratory protection
    e. occupational head protection
    g. occupational foot protection
    h. electrical protective devices

PLANNING, IMPLEMENTING, AND MAINTAINING THE USE OF PROTECTIVE EQUIPMENT

In the last part of this lesson, we will be talking about ways to help plan, implement and maintain personal protective equipment. This can be considered in terms of the following nine phases: 1) Need Analysis, 2) Equipment Selection, 3) Program Communication, 4) Training, 5) Fitting and Adjustment, 6) Target Date Setting, 7) Break-in Period, 8) Enforcement, and 9) Follow-through.

The first phase of promoting the use of personal protective equipment is called NEED ANALYSIS. Before selecting protective equipment, you need to determine what hazards or conditions the equipment must protect the employee from. To determine this, ask yourself questions such as the following:

- What standards does the law require for this type of work in this type of environment?
- What needs do our accident statistics point to?
- What hazards have we found in our safety and/or health inspections?
- What needs show up in our job analysis and job observations activities?
- Where is the potential for accidents, injuries, illnesses, and damage?
- Which hazards can't be eliminated or segregated?

36. Where would you look to find the appropriate standards for this lesson?

37. Where can you find out what the accident statistics are in your establishment?

_____

_____

38. Before you resort to using PERSONAL PROTECTIVE EQUIPMENT, it is important to try to _____ or _____ hazards.

The second phase of promoting the use of protective equipment is EQUIPMENT SELECTION. Once a need has been established, then proper equipment must be selected. Basic consideration should include:

- Conformance to the standards
- Degree of protection provided
- Relative cost
- Ease of use and maintenance
- Relative comfort

ANSWERS TO QUESTIONS:

36. OSHA standards

37. From the recordkeeping forms required by the law, and other records available in your establishment.

38. eliminate segregate

Obtain technical advice when determining what types of equipment to buy.

39. What are the first two phases of promoting the use of protective equipment?

    a. _____

    b. _____

The third phase is PROGRAM COMMUNICATION. You should not simply announce a protective equipment program, put it into effect, and expect to get immediate cooperation. Employees tend to resist change unless they see it as necessary, comfortable, or reasonable. It is helpful to use various approaches to publicity and promotion to educate employees as to why the equipment is necessary. Various points can be covered in supervisors' meetings, in safety meetings, by posters, on bulletin boards, in special meetings, and in casual conversation. Gradually, employees will come to accept, even to expect or to request, protective equipment to be used in their job.

EDUCATION AND MOTIVATION ARE IMPORTANT

The main points in program communication are to educate employees as to why protective equipment is necessary, and to motivate them to want it and use it.

40. The next phase in promoting the use of personal protective equipment is TRAINING. What were the first three phases?

    a. _____

    b. _____

    c. _____

Training is an essential step in making sure protective equipment will be used properly. The training should cover why the equipment is necessary, when it must be used, who must use it, where it is required, what the benefits are, and how to use it and take care of it.

EMPLOYEE TURNOVER

Don't forget that employee turnover will bring new employees into the work area. Therefore, you will continually need to train these new employees in the use of the protective equipment they will handle. They will need training as well as the other procedures discussed in the remainder of this lesson.

ANSWERS TO QUESTIONS:

39. a. Need Analysis b. Equipment Selection

40. a. Need Analysis; b. Equipment Selection; c. Program Communications

---

After the training phase comes the FITTING AND ADJUSTMENT phase. Unless the protective equipment fits the individual properly, it may not give the necessary protection.

There are many ways to fit or to adjust protective equipment. For example: face masks have straps that hold them snug against the contours of the head and face and prevent leaks; rubberized garments have snaps or ties so they can be drawn up snugly and kept from being loose and flopy and getting caught in machinery; and many others. The important point is to make sure the personal protective equipment really fits the employee or else it will not provide the protection it is intended to give.

The next phase is TARGET DATE SETTING. After you have completed the other phases, you will need to set specific dates for completion of the various phases. For example, all employees shall be fitted with protective equipment before a certain date; all training shall be completed by a certain date; after a certain date, all employees must wear their protective equipment while in the production area.

After you set the target dates, you should have a BREAK-IN PERIOD. There will usually be a period of psychological adjustment whenever a new personal protective program is established. Two things to remember are:

- To expect some gripes, grumbles, and problems;
- To give appropriate consideration to each individual problem and strive toward a workable solution.

It might also be wise to post signs that indicate the type of equipment needed. For example, a sign might read "EYE PROTECTION MUST BE WORN IN THIS AREA."

41. Will some of the complaints from employees about new protective equipment be realistic?

    a. Yes

    b. No

After the Break-In Phase comes ENFORCEMENT. If all of the previous phases were successful, you should not have many problems in terms of enforcement. In case disciplinary action is required, sound judgment must be used and each case evaluated on an individual basis. Some employers follow the rules below for disciplinary action.

- First offense --- an oral warning
- Second offense --- a written warning
- Third offense --- one week's suspension
- Fourth offense --- two weeks' suspension
- Fifth offense --- discharge

ANSWERS TO QUESTIONS:

41. a. Yes. You should study these complaints carefully to determine which ones have merit. Complaints can sometimes be useful in determining whether the correct protection equipment has been bought or whether the fitting is correct, or whether the employees have been adequately trained to use or maintain their protective equipment.

These actions may seem harsh, but if employees fail to use protective equipment, they may be exposed to hazards. Don't forget, the employer can be penalized if the employee does not use his protection.

The final phase after enforcement is FOLLOW-THROUGH. While disciplinary action may sometimes be necessary, positive motivation plays a more effective part in a successful protective equipment program. One type of positive motivation is for you to set a proper example. You must wear your own equipment, just as you expect those employees you supervise to wear theirs.

Using protective equipment as a subject of safety talks and demonstrations can also have a positive motivating effect. Positive motivation can be gained from including personal protection in themes; carefully designed buttons, badges, banners and brochures; and in contests that can lead to awards for those with exemplary performance in use of protective equipment. Safety clubs that give recognition to employees for avoiding serious injury, by proper use of their personal protection, also are positive motivating forces. A few examples of safety clubs that are active in certain establishments are:

- Turtle Club --- Hard Hats
- Scarab Club --- Safety Shoes
- Half Way to Hell Club --- Safety Nets
- Wise Owl Club --- Eye Protection

43. What is the final phase of promoting the use of personal protective equipment?

_____

THE ENFORCEMENT PHASE

44. As an employer representative, is it part of your job to enforce the use of personal protective equipment?

    a. Yes

    b. No

ANSWERS TO QUESTIONS:

43. Follow-through

44. a. Yes

THESE NINE PHASES ARE HELPFUL

45. By using these nine phases to promote the use of personal protective equipment, you not only will be following the law; you also will be helping your employer and, most importantly, you will be preventing injuries or illnesses to fellow humans and preserving our human resources. See if you can name the nine phases:

a. _____ f. _____

b. _____ g. _____

c. _____ h. _____

d. _____ i. _____

e. _____

PROTECTION FOR ALL IS REQUIRED

46. One important point to remember with regard to all protective equipment is that everyone is required to wear protective equipment when going through a hazardous area. Does this mean that a Compliance Officer must use protective equipment if he goes into a hazardous area?

a. Yes

b. No

REVIEW

47. What are the three methods used to control hazards?

a. _____

b. _____

c. _____

48. Will one type of protective equipment protect employees from all different kinds of hazards?

a. Yes

b. No

ANSWERS TO QUESTIONS:

45. a. Need Analysis
    b. Equipment Selection
    c. Program Communication
    d. Training
    e. Fitting and Adjustment
    f. Target Date Setting
    g. Break-in Period
    h. Enforcement
    i. Follow-through

46. a. Yes. Everyone includes a compliance Officer.

47. a. elimination of the hazard
    b. segregation of the hazard
    c. protection from the hazard

48. b. No. Special hazards require special protective equipment.

---

49. The use of protective equipment eliminates hazards.

    a. True

    b. False

50. _____ and _____ protectors are required for employees performing operations such as grinding and sandblasting.

51. _____ are required to protect employees from airborne contaminants.

52. Employers are required to keep records on all employee exposure to _____ materials.

53. A gas mask supplies air to the employee from an external source such as a compressed air tank.

    a. True

    b. False

54. Since the oxygen supply of supplied-air respirators comes from a distant source (up to 300 feet away), what safety precaution is required by the Act?

    a. An extra respirator available for the employee working under hazardous conditions

    b. A helper if rescue is needed

55. Does a closed-circuit respirator recirculate the oxygen?

    a. Yes

    b. No

56. Is foot protective equipment limited to protection from falling objects?

    a. Yes b. No

ANSWERS TO QUESTIONS:

49. b. False. The protective equipment protects from the hazard, but the hazard remains and must be respected.

50. eye face

51. respirators

52. toxic

53. b. False

54. b. A helper to tend the line and make a rescue if necessary.

55. a. Yes. Eventually, of course, all the available oxygen is used and the unit must be recharged with more oxygen.

56. b. No. There are many different kinds of foot protectors.

---

57. _____ is an example of insulating material that protects employees from electrical injury, assuming it is thick enough.

58. The last resort for controlling hazards is the use of _____ equipment.

59. One of the most important aspects of developing a program for the use of protective equipment is the _____ of employees to use and maintain their equipment.

60. Wearing your protective equipment as you would expect those you supervise to is a good example of positive _____.

61. By promoting the use of protective equipment in your work area, you help to insure the _____ and _____ of those you supervise.

This lesson should have helped you in recognizing the need for specific types of personal protective equipment, depending upon hazards in the work area that cannot be eliminated or segregated. You also should have a good beginning knowledge in planning and executing a program to use equipment of this nature.

All work that you accomplish toward such purpose will benefit employees' health and safety and, at the same time, assist in keeping in compliance with the OSHA standards.

ANSWERS TO QUESTIONS:

57. rubber (some of the new plastics will also work.)

58. personal protective

59. training/educating/instructing

60. motivation

61. safety health

LESSON 10

EMERGENCY CARE PROCEDURE

The purpose of this lesson is to instruct you in certain critical emergency care procedures—procedures that could save the life of those you supervise (or your family, or yourself).

MEDICAL AID FOR EMPLOYEES IS REQUIRED BY THE ACT

Proper health care is an important part of the Act. The use of doctors or people trained in first-aid techniques will help not only in saving lives but also in helping to determine what toxic materials are present which are harmful to employees.

Some establishments are large enough to employ a full-time or part-time physician. Others employ nurses and use the consulting services of a physician. Many smaller establishments have no medical help at all. Regardless of the size of an organization, all employers and employees should know the requirements of the law.

The OSHA standards have a section (Part 1910 Subpart K) entitled MEDICAL SERVICES AND FIRST AID. Here is what it says:

"(a) The employer shall ensure the ready availability of medical personnel for advice and consultation on matters of plant health.

"(b) In the absence of an infirmary, clinic, or hospital in near proximity to the workplace which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. First-aid supplies approved by the consulting physician shall be readily available.

"(c) Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use." (Section 1910.151)

From the information you read in above item, the OSHA standards indicate that if an infirmary, clinic, or hospital is not near the workplace that is used to treat injured employees, a person should be trained in proper first-aid techniques. The trained person can be anyone in the area. It need not necessarily be the supervisor. Also, keep in mind that if there is only one person with the first-aid training, he might not be around at the time of need. This suggests that several people in your area should have such training so you will be more likely to have at least one on hand at any given time.

The OSHA standards also state that an employer needs to make medical personnel available for advice and consultation for matters of plant health. Small establishments can use part-time personnel if they cannot afford full-time medical personnel. But if they use part-time medical personnel, they must be readily available.

1. Additional requirements in the Standards state that your establishment must have first-aid supplies available that are approved by a _____.

Having first-aid supplies on hand in all work areas is not enough. When employees work with harmful materials, other facilities are needed to protect them from illness or injury. If a person is exposed to harmful materials, emergency facilities for quick drenching or flushing of the eyes and body should be provided directly in the work area. Special showers and eye baths are commercially available. Architects

ANSWERS TO QUESTIONS:

1. doctor/physician

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and industrial engineers know how to get them. Industrial hygienists or safety engineers know how to use them.

It is important to keep in mind that the Act stresses the need to protect employees from safety and health hazards. While the standards for medical services and first aid may seem to be interested in only the health of an employee, these standards also have implications for employee safety. In many instances, it is impossible to separate the safety of an employee from the health of an employee.

Regardless of the availability of doctors or other medical aid, there are some emergencies that require IMMEDIATE action to save a life until professional help becomes available. Sometime you may be the only person available to SAVE A LIFE!

This lesson is not a full course in first aid. It covers just a few main points. However, you are strongly encouraged to take a more complete course if at all possible. If you do, you could qualify as one of the persons "... adequately trained to render first aid," as the standard requires. Obviously, any first-aid knowledge you have may help you in saving the lives or health of your employees.

Some first-aid skills are directed at keeping employees from suffering further damage after the initial accident. An example of this is knowing how to handle a person with a broken neck or back. One mistake at that point can mean paralysis for life. Another example is knowing how to restore breathing after electrical shock. Wait too long to start him breathing again and the person will have suffered permanent brain damage. The person may be alive after that but his health has been permanently ruined. Appropriate critical emergency care techniques can really help minimize the impact of both injuries and sickness.

Another reason for your taking this lesson is that you would be the best teacher for these emergency first-aid techniques, since you know the employees and the hazards in your work area. The more employees in your work area that know these emergency first-aid techniques, the better the chance of an employee's life or health being saved and protected.

TECHNIQUES FOR CORRECTING NONBREATHING

There is a saying that people can live three weeks without food, three days without water, but only about three minutes without air. It is absolutely essential that an injured person begin to breathe again as soon as possible. Therefore, one of the most important critical first-aid techniques we will talk about is what you can do to start a person breathing again.

Before you can understand first aid for nonbreathing, you should know something about how we do breathe. The body normally controls the breathing mechanism by muscular movements which enlarge the chest cavity, causing air to flow into the lungs; and other movements of the muscles, decreasing the cavity, which causes the flow of air out of the lungs. Breathing requires an open air passage from the nose or mouth to the lungs and an alternating increase and decrease in the expansion of the chest cavity. One of our first concerns in emergency care is to make sure the person is breathing. In cases of nonbreathing, artificial respiration is essential. Artificial respiration is the procedure for causing air to flow into and from the lungs by artificial means when the person can't breathe for himself. For a normal adult at rest, the average rate of

breathing is about 16 or 17 times per minute. Artificial respiration should try to create a nearly normal breathing rate. For adults, a range of 12 to 16 times per minute would be fine.

2. When giving artificial respiration to an employee, what would be the rate of breathing you would try to maintain?

The best method of artificial respiration is the mouth-to-mouth technique. This has the advantage that you need no equipment and you can provide pressure to inflate the victim's lungs immediately. It is the only technique with which you can be sure that you are supplying enough oxygen to sustain life. It can be used even on people pinned down by something. This technique can be used to help both employees who are having a hard time breathing and those not breathing at all.

You need no equipment to perform the mouth-to-mouth technique. It works best with the patient lying flat on his back, but it can also be given to a victim in almost any position if it has to be (even if victim is trapped on his side, or seated, or face down).

3. The best method of artificial respiration is the _____ _____ _____ technique.

You will be given instructions below on how to do the mouth-to-mouth technique. Refer to the illustration on the next page while you read the following instructions.

- Figure 1. Check to see that the employee's air passage is clear. You would do this by placing the victim on his back if this is possible. Remember, this technique can be given to a victim in almost any position. Next, turn the victim's head to one side and look in his mouth and throat for foreign matter. Look carefully! Foreign matter should be wiped or pulled out with the finger. Do not use any kind of tool if you can avoid it. Using a tool will probably do nothing more than push any foreign matter further down in the throat.

You should always check for obstructions in the air passage by opening the victim's mouth amd using your fingers to check for obstructions. Keep in mind that the air passage means more than just the victim's mouth. The air passage also includes the victim's throat. There are many types of obstruction that you can find in a victim's air passage. This includes such things as mud, broken teeth, vomit, the victim's tongue, and food or other things that have been only half swallowed.

THE VICTIM NEEDS A CLEAR AIR PASSAGE

- Figure 2. After you have cleared the air passage, you should do the following:

  With one hand, lift the victim's neck upward as you tilt the head back. This extends the throat region to allow for a clear air passage. The chin can be pulled or pushed downward into a jutting-out position so that the tongue won't fall back to block the air passage. Watch that tongue! An unconscious person may swallow it. If this happens, pull the victim's tongue back in its proper position and hold it there. It is wise to keep holding the tongue because the victim may swallow it again.

4. How can you keep the air passage open?

5. Why do you push down on the chin?

MOUTH-TO-MOUTH RESUSCITATION

1. Clear the air passage.

2. Lift up under neck (extend chin) and pinch the nostrils together.

3. Inhale deeply. Breathe into victim's mouth.

4. Remove mouth, listen for return flow of air.

ANSWERS TO QUESTIONS:

2. 12 to 16 times per minute

3. mouth-to-mouth

4. Lift the neck upward and tilt the head back.

5. To prevent the tongue from blocking the air passage.

BLOW AIR INTO THE VICTIM'S LUNGS

- Figure 3. Now that the air passage is clear, hold the victim's mouth open, open your own mouth wide and tightly place it over the victim's mouth. Pinch the victim's nostrils shut to prevent air from escaping through them. Blow forcibly into the victim's mouth. If an obstruction to the air passage is still there, you will be able to feel resistance to your first efforts. If there is still an obstruction, turn the victim on his side and give several sharp blows to his back between the shoulder blades, to dislodge the foreign matter. When the air passage is clear, start blowing into his mouth again.

6. When doing the mouth-to-mouth technique, how do you keep air from coming out of the victim's nose?

7. As you start blowing in the victim's mouth, suppose you find that there is an obstruction in the air passage. How do you clear the air passage?

HOW TO DETECT BREATHING

- Figure 4. You have just blown FORCIBLY into the victim's mouth. Remove your mouth and, as you inhale, turn your ear toward the victim's mouth to listen for the return flow of air from the victim's lungs. Repeat the blowing effort. Blow vigorously at the rate of 12 to 16 breaths per minute. If you cannot hear any air coming out of the victim's lungs, raise the neck higher and tilt the head slightly more. Out of the corner of your eye you will be able to see the victim's chest expand if you are successful in breathing air into his lungs. When you take your mouth away, his chest will get smaller.

8. How can you tell whether air is getting into the victim's lungs?

9. Using the letters a. through e., put the following basic mouth-to-mouth techniques in their proper order:

   - Lift the victim's neck upward and tilt the head back. ____
   - Listen for the return flow of air from the victim's lungs. ____
   - Check for a clear air passage. ____
   - Blow into the victim's mouth while holding his nose shut. ____
   - Clean out any obstruction with your fingers. ____

ANSWERS TO QUESTIONS:

6. By pinching his nostrils shut.

7. You turn the victim on his side and hit him sharply on his back, between the shoulder blades. Then sweep your fingers through his mouth and down his throat to remove any foreign matter.

8. His chest will rise and fall.

9. c., e., a., d., b.

The mouth-to-mouth technique is the most efficient and is recommended by leading authorities. However, people who cannot or will not use this method can use other methods that are taught in first-aid courses. All methods require that the air passage be clear. Whether you use pressure on the back or chest pressure and arm lifting, the most important thing is to produce an alternating increase and decrease in the expansion of the chest cavity (approximately 12 times a minute).

Again, it should be mentioned that it would be much better if you took a formal first-aid course. You would not only learn a variety of techniques, but you would also get a chance to practice these techniques. For information about first-aid training, contact the American Red Cross, your local Fire Department, or any other reputable source for information on where instruction can be obtained.

TECHNIQUES TO CONTROL SEVERE BLEEDING

The second critical first-aid technique we will talk about is the control of SEVERE BLEEDING. The average person has about six quarts of blood. His heart will pump nearly that much (about five quarts) every minute. When a major blood vessel is cut, it is possible to bleed to death in minutes—each second counts. The ability to control severe bleeding is an urgently needed first-aid technique. The objective of this technique is to stop bleeding at once.

10. Which of the following would you do first for an employee who suffers severe bleeding:

    a. Start him breathing again?

    b. Stop the bleeding?

To control bleeding, apply direct pressure over the wound. Use a sterile bandage or cloth out of the first-aid kit, if one is immediately available. Otherwise, any clean cloth or even a clean part of your clothing or the victim's clothing can be used in emergency. This cloth needs to be as clean as possible to prevent infection. You may have to use your bare hand for quick action if a clean cloth is not available fast enough.

11. What are you guarding against when you use a clean cloth or clean hand to control bleeding?

12. You are usually able to stop bleeding by applying direct pressure over the _____.

Apply the direct pressure over the wound until bleeding is controlled. After the bleeding is controlled, additional layers of cloth can be added and bandaged snugly in place to keep pressure on the wound. However, make sure the bandage is not so tight that it will stop circulation. Once the bleeding is controlled, the dressing should not be removed except by medical personnel.

ANSWERS TO QUESTIONS:

10. b. Stop the bleeding. He may be able to live without breathing for about three minutes, but could die from loss of blood in less than that time.

11. Infection

12. Wound/cut

---

13. If you tie a bandage too tightly, it will permanently stop the _____ of the blood and will damage tissues that can never be replaced.

14. Should YOU remove the dressing after the bleeding has stopped?

    a. Yes

    b. No

There are certain points in the body to which you can apply pressure to control bleeding in the arms or legs. These points in the body are called PRESSURE POINTS. Using your fingers or the heel of your hand, you can apply pressure to flatten the blood vessel or artery against the underlying bone.

This pressure will diminish the flow of blood to the wounded area, thus controlling the bleeding.

ILLUSTRATIONS OF THE PRESSURE POINTS

Turn to the following illustrations for examples of where pressure points can be found in the human body. Refer to these diagrams while you read the following information:

- Figure 1. Pressure on the inner part of the upper arm, midway between the elbow and the armpit (see arrow), will diminish bleeding from any part of the arm below the point of pressure.

- Figure 2. Pressure can be applied just below the groin on the front (see arrow), inner half of the thigh (the point where the crease of a man's trousers would intersect the imaginary line formed where his leg joins the trunk of his body). This compresses the legs's blood artery against the underlying pelvic bone and reduces bleeding from below that point.

15. Pressure points are used by pressing your fingers or the heel of your hand on a blood _____ compressing it against the underlying _____ .

APPLYING PRESSURE TO THE WOUND

16. What would you use to apply pressure to the blood vessel?

17. The arrows in Figures 1 and 2 of the illustration are examples of _____ _____ .

18. Pressure points are used to control bleeding in the _____ or _____ _____ .

ARM and SHOULDER

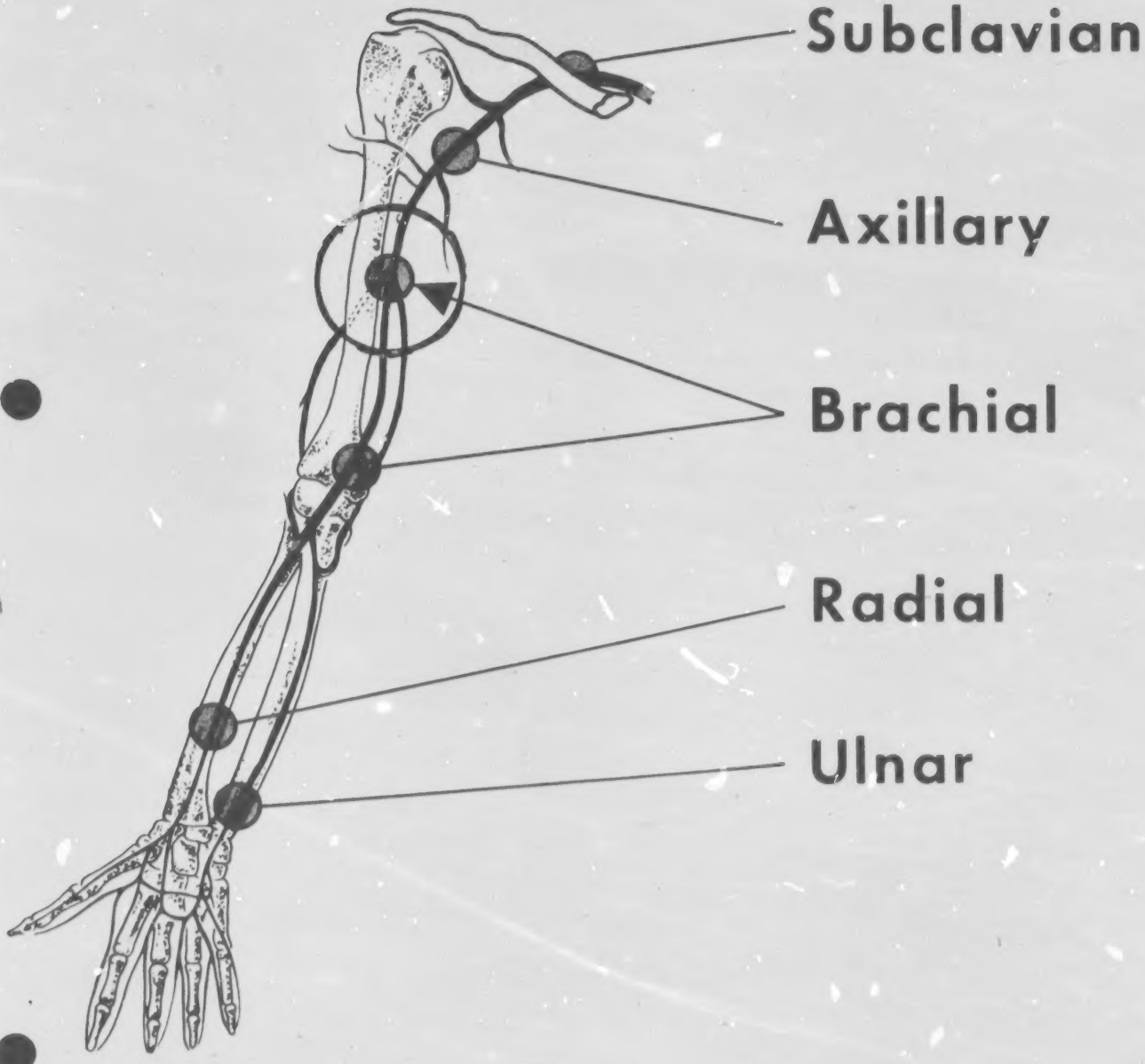


FIGURE 1

LEG and FOOT

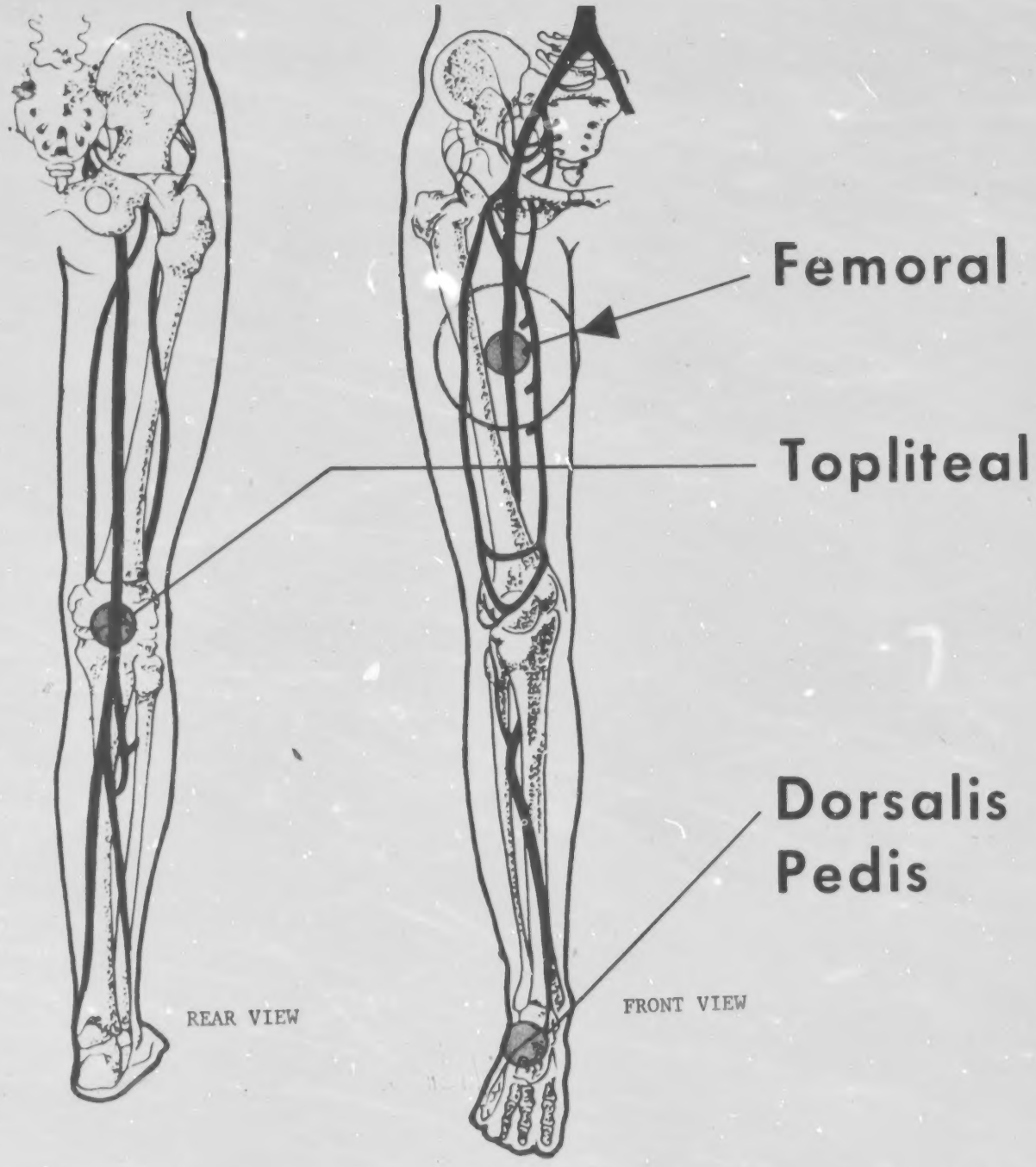


FIGURE 2

ANSWERS TO QUESTIONS:

13. Circulation

14. b. No. The dressing should not be removed after the bleeding has stopped since it is very easy to open up the wound again and cause heavy bleeding to start again. Let medical personnel handle this.

15. vessel bone

16. Your fingers or the heel of your hand.

17. Pressure points

18. (any order) arteries

Only as a LAST resort should a tourniquet be used. The use of a tourniquet is actually A RISK TO SACRIFICE A LIMB IN ORDER TO SAVE A LIFE. Once a tourniquet is used, you should not remove it—and medical help is needed quickly. Its application may cause tissue damage because it completely shuts off the entire blood supply to the body part below. When improperly applied, the device itself often seriously damages underlying tissues. It is a last resort, to be used only when large vessels are severed or in cases of partial or complete severance of a body part, wnere severe hemorrhage cannot be controlled by direct hand pressure or pressure bandages—and could result in loss of life.

19. A tourniquet that is applied too tightly can cause _____ damage.

The following is a description on how to apply a tourniquet. Refer to the following illustration while you are reading this description. A triangular bandage, folded into a 3" wide bandage, can be used for a tourniquet. Improvised tourniquets can be made from flat materials about 2" wide (a necktie, stocking or part of clothing). Commercial tourniquets are often available in first-aid kits. Avoid using ropes or wires which may cause serious injury to underlying tissue.

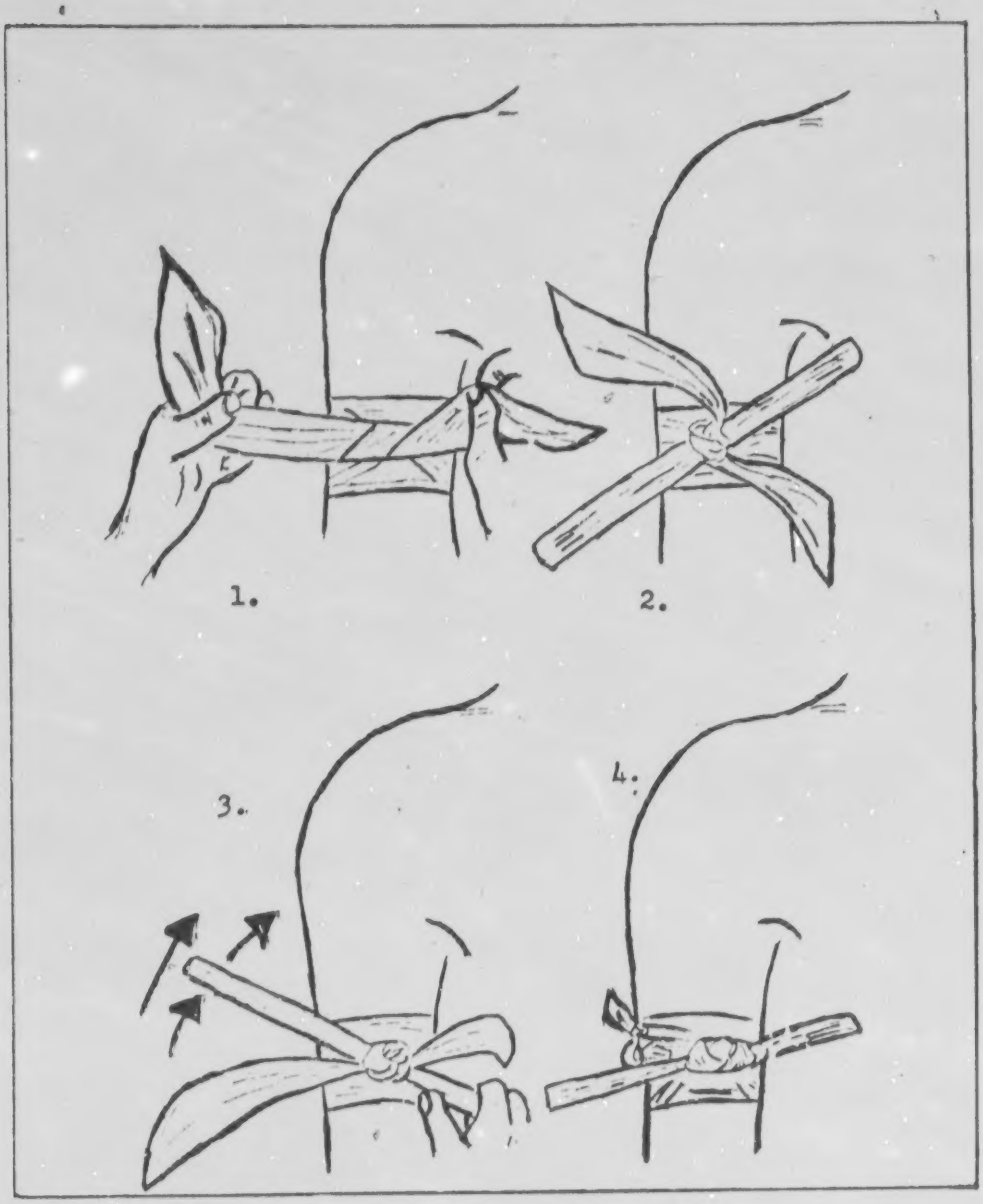
Wrap the material tightly twice around the limb if possible, and tie a half knot. Place a tightener (short stick, screwdriver, or similar sturdy article) on the half knot and tie a full knot. Twist the tightener of the tourniquet until the flow of blood stops. Secure the tightener in place with loose ends of the tourniquet cloth or other improvised material, to prevent unwinding.

20. In your own words, why shouldn't you use ropes or wires for a tourniquet?

THE BASIC STEPS OF APPLYING A TOURNIQUET

21. Using the letters a. through e., rearrange the following in their proper order:

- tie a half knot
- tie a full knot
- wrap the material tightly twice around the limb
- place the tightener on the half knot
- twist the tightener until the flow of blood stops



HOW TO APPLY A TOURNIQUET

ANSWERS TO QUESTIONS:

19. Tissue

20. Because they will injure the underlying tissue.

21. c., a., d., b., e.

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22. Remember, a tourniquet is the last resort since there is a good chance of _____ damage and loss of a _____ .

Additional aid to help stop bleeding can be given by elevating the wounded part, if possible, and keeping the victim quiet until medical help arrives. If a tourniquet is used, make sure it is used properly and that the medical person who treats the patient is aware of it, its location, and the time it was applied. Again, we emphasize that a formal first-aid course can be most beneficial in learning complete treatment for all types of wounds.

For all serious injuries, send for professional aid immediately. Do not move the victim. If the victim must be pulled to safety because of imminent danger, he should be pulled in the direction of the LONG axis of his body, not sideways.

If an imminent danger does not exist, do not move the victim.

As explained in earlier lessons, imminent danger refers to situations where there is an immediate possibility workers will be killed or seriously injured. Situations like this would include fires, possibility of explosion, or any other condition where people can be seriously harmed in the immediate future.

23. The most important point to remember when trying to stop severe bleeding is to apply direct _____ over the wound.

TECHNIQUES FOR TREATING TRAUMATIC SHOCK

The third emergency technique we will discuss is the treatment of TRAUMATIC SHOCK. Traumatic shock is, primarily, a rapid fall in blood pressure following a serious injury. Traumatic shock should be suspected in all serious injuries. Shock is generally caused by loss of large quantities of blood either externally or into the tissues or body cavities, resulting in depressed condition of many of the body functions. Shock may be produced or made worse by any movement that increases hemorrhage or causes it to recur. It is, therefore, important to keep the victim lying down flat. The feet can be elevated 8 to 12 inches (for improved blood flow to vital organs), except when head or chest injuries are evident or when the position causes greater pain. If there is chance of neck, back, or body injuries, it is best not to move the patient at all. Whenever in doubt, keep the victim lying flat.

24. It is most important to keep a victim lying _____ when he is in shock, or in the case of serious injury.

25. Should you move an employee who is in shock?

a. Yes b. No

ANSWERS TO QUESTIONS:

22. tissue limb

23. Pressure. Direct pressure is the best and quickest method to stop severe bleeding.

24. Flat. Keeping the victim lying flat helps blood circulation, it is easier on the heart, wounds aren't disturbed, nerves won't be severed, and it is more restful for the victim.

25. b. No, unless there is imminent danger. As stated earlier, imminent danger can include the possibilities of fire, explosion, or the near collapse of a building wall.

---

26. If you suspect shock and head or chest injuries, should you elevate the victim's feet?

    a. Yes

    b. No

It is important to prevent a large loss of body heat from the victim and to maintain reasonably normal body temperature. A blanket may be needed to cover the victim for warmth, but it should not be used if it would tend to make him sweat. A blanket may be placed under the victim unless back injuries are suspected, in which case he should not be moved at all. A blanket properly tucked around his body will give considerable protection, even from a cold floor. If you don't have a blanket, use a couple of coats. The victim may be given sips of plain drinking water to quench his thirst. No fluids should be given if he is unconscious, nauseated, or if abdominal wounds are evident. Treatment of shock is important, since shock too often results in death—although the initial injury itself would not have been fatal.

27. What three conditions would prevent you from giving liquids to a victim in shock?

    a. _____

    b. _____

    c. _____

28. Absolutely, do not _____ any victim if he has a back or neck injury.

29. In general, a shock patient should not be moved unless there is _____ danger.

30. For all three critical first-aid conditions discussed, it is important that you contact a _____ _____ immediately.

To comply with the OSHA standard 1910.151(b), you must keep first-aid supplies on hand.

It is important that a sufficient quantity of the proper first-aid supplies be kept right in your work area. These supplies should be selected with the help of a consulting physician. It would be most helpful if you would qualify yourself as a trained first-aider. In a formal first-aid course, you would learn treatment for a broad variety of sicknesses and injuries. It would include, for example, wounds, burns, fractures, sprains, strains, insect bites, heart attacks and others. First-aid kits are available for general first-aid treatment. The kit should be large enough and have the proper contents for the needs of the area it must serve. The

ANSWERS TO QUESTIONS:

26. b. No. If you try to move a victim who has head or chest injuries, such a move may cause more extensive damage or even death. For example, moving an employee who has broken ribs may cause a rib to puncture the lungs or heart.

27. a. nausea b. unconsciousness c. if abdominal wounds are evident

28. Move. The reason is that you might cause a broken bone to cut his spinal cord and that might paralyze him for life.

29. Imminent

30. Doctor/physician/nurse--If none of these is available, someone with first-aid training will have to do. Most firemen and policemen and ambulance squad members have had first-aid training.

---

supplies should be arranged so they can be found quickly without unpacking the entire kit. Materials need to be properly wrapped to remain clean or sterile. In many establishments, typical kits contain several different sizes of bandage compresses, adhesive tape, gauze pads, roller bandages, absorbent gauze, triangular bandages, tweezers and scissors. You should personally check the kit once in a while to be sure the supplies are fresh and clean, and that they haven't been used or stolen.

31. If you took a first-aid course and qualified as a trained first-aider, you would be meeting a requirement that is stated in the _____ found in the OSHA standards.

You also need to know the procedure to follow in event of emergency. It would be wise to post phone numbers for emergency calls beside every phone. Emergency measures to stop machinery or operations need to be clearly marked. Seconds may be the difference between life and death. Remember, lives may be saved if you have the proper emergency phone number handy.

This means time will not be wasted in calling for emergency help, or time wasted because of getting a wrong number. This means anyone will be able to call for emergency aid.

Posting shutdown procedures for machinery or operations may also save lives since less time will be needed in closing down operations and evacuating the premises if required.

All employees should be instructed in emergency procedures. Drills could be conducted, very much like a fire drill, for various types of emergencies. Each employee should know his responsibility in case of emergencies. This is an area where you can make a great contribution as a leader. You can assume responsibility for much of the communication, motivation, and training of employees. By training your people in emergency procedures and critical first-aid techniques, you are showing concrete evidence of good human relations . . . of your real interest in them as human beings. What could be more humane than helping to prepare people to preserve lives? Another benefit of your emphasis on emergency care is that it will help create an "increased awareness" of safety and health in your employees. Conducting instruction in emergency procedures will help in the possible saving of lives when an emergency arises in your work area.

One of your important jobs as a supervisor is to train your employees in safe evacuation procedures. A speedy, but orderly, evacuation will minimize the loss of human lives during an emergency.

Training your employees in their responsibilities during an emergency will help cut down on confusion that so often results during an emergency. With proper training they will know the correct procedures to follow.

ANSWERS TO QUESTIONS:

31. Standard. It requires that someone in the work area be officially trained in first aid. Why not make yourself that person!

From the information you have received at this point, you can probably see that there is a need for trained personnel to administer first aid to employees for such things as NONBREATHING, SEVERE BLEEDING, and TRAUMATIC SHOCK. This lesson taught the fundamentals of several techniques, but in no way covers the range of first-aid problems that can be encountered in your work area. Because there are other problems that can be encountered in your work area, it is strongly recommended that you, or someone in your work area, take a formal first-aid course. Remember, having formal first-aid training will ensure that no lives will be lost due to employees not knowing what to do to start an employee breathing again, or stopping severe bleeding.

REVIEW

32. The OSHA Standards require that an employee be trained in _____ if there is no infirmary, clinic, or hospital in near proximity to the workplace which is used for treatment of all injured employees.

33. The most recommended technique to use for nonbreathing is called _____ _____ resuscitation.

34. When using the mouth-to-mouth technique, make sure that the air passage is clear of all _____ _____ matter.

35. What is the last resort you should try for severe bleeding?

36. Severe bleeding can also be controlled by applying direct pressure to _____ points in the body.

37. The most approved method for stopping severe bleeding is to apply direct pressure over the wound by _____ or _____ .

38. No matter what type of severe injury is present in the victim, always suspect and treat for _____ _____ .

39. Unless in cases of imminent _____ , keep a shock victim lying flat and maintain normal body temperature.

40. Would you classify the following as imminent danger?

    a. Fire _____

    b. Explosion _____

41. First-aid supplies must be readily available and must be approved by a consulting _____ _____ .

42. Supervisors can make a great contribution by taking first-aid training and by communicating, motivating, and _____ employees in proper first-aid techniques.

ANSWERS TO QUESTIONS:

32. First aid

33. Mouth-to-mouth

34. Foreign. Any foreign matter in the air passage will make it difficult, if not impossible, to get air into the victim's lungs.

35. The tourniquet. This technique should be used as a last resort because of the possibility of severe tissue damage and the possibility of loss of a limb.

36. Pressure

37. Hand bandage

38. Shock

39. Danger

40. a. Yes b. Yes

41, Physician/doctor

42, Instructing/training

LESSON 11

FIRE LOSS CONTROL

Upon completion of this lesson, you should be able to recognize the fire hazards in your work area, then classify and evaluate these hazards. In addition, you will learn how to select the proper fire extinguishers to match the various types of fires and some helpful information in training your employees in fire protection and control.

FIRE LOSS CONTROL

The Federal Standards issued to implement the Occupational Safety and Health Act of 1970 make many references to fire hazards. Fire protection is the subject of one section of the standards, (CFR 1910.156 Subpart L). Why is this? One big reason is that industrial fires kill or maim many people each year. This lesson covers the basic principles of fire prevention and protection. It includes information about means to prevent fire and to protect personnel from the effects of fire.

1. When you are looking for fire hazards in your workplace, remember that an ordinary fire occurs ONLY when three basic elements are COMBINED: fuel, heat, and oxygen.

	Yes	*No*
a. According to this premise, when fuel and heat are combined, but there is NO oxygen, can you have a fire?	_____	_____
b. When oxygen and fuel are combined, but there is NO heat, can you have a fire?	_____	_____
c. When oxygen and heat are combined, but there is NO fuel, can you have a fire?	_____	_____

2. A fire in your workplace can result from the COMBINATION of what three elements?

   a. _____

   b. _____

   c. _____

To extinguish a fire in your workplace, any one of the following actions can be taken. Complete the sentences in Column A, using the phrases in Column B.

A	*B*
3. Heat can be reduced by	a. excluding the air
4. The amount of oxygen can be reduced by	b. shutting it off or removing it to a safe area
5. Fuel can be taken away by	c. cooling the material that is burning

ANSWERS TO QUESTIONS:

1. a. No	b. No	c. No
2. a. Fuel	b. Heat	c. Oxygen
3. c.	4. a.	5. b.

You can cool off a fire in your workplace by applying a substance to absorb the HEAT. The most common agent used to cool a fire is WATER. Water reduces the heat because it is a good cooling medium. Water CANNOT be used on all kinds of burning materials; however, more about this later in the lesson.

You can reduce the amount of oxygen available to a fire in your workplace by applying an agent to SMOTHER the burning area. Covering the area with dry chemicals is one way of smothering the fire. Throwing dirt or sand on the fire would be another way of excluding air. Foam also smothers a fire. In addition, foam cools a fire somewhat because of the water in the foam.

If flammable gases catch fire as they flow from a pipe directly outside your workplace and you manage to put out the fire by shutting off the source of the gases that are burning, this would be an example of removing the fuel from the fire.

There are different ways of putting out fires, depending on what is burning. For example, you can use water to extinguish a wood fire in your workplace, but you should not use water in liquid form for grease fires, fires involving energized electrical equipment, or burning metal. However, water in the form of fog will rapidly form steam in the presence of heat and can be used effectively for grease fires or fires involving energized electrical equipment.

6. The OSHA Standards divide fires into four classes according to the material that is burning and what it takes to put it out. Indicate for each class of fire below whether WATER in liquid form should be used to extinguish it.

Class of Fire	*Burning Material*	*Yes*	*No*
A	wood	_____	_____
B	grease	_____	_____
C	energized electrical equipment	_____	_____
D	metal	_____	_____

IN ADDITION TO WOOD FIRES, FIRES IN OTHER ORDINARY COMBUSTIBLE MATERIALS LIKE PAPER, CLOTH, RAGS, RUBBER, AND TRASH ARE CALLED "CLASS A" FIRES. If you have a fire in a pile of wood shavings in your woodworking shop, this is an example of a Class A fire.

7. Saying that Class A fires are fires in ordinary combustible materials like wood, paper, and cloth is an example of classifying fires on the basis of which of the following:

   a. the material that is burning

   b. what it takes to put the fire out

ANSWERS TO QUESTIONS:

6. A. Yes B. No C. No D. No

7. a.

EXTINGUISHANTS TO USE FOR CLASS A FIRES

IT IS IMPORTANT FOR YOU AND THE EMPLOYEES YOU SUPERVISE TO KNOW THE RIGHT TYPES OF "EXTINGUISHING AGENTS" TO PUT OUT EACH CLASS OF FIRE THAT MIGHT OCCUR IN YOUR WORKPLACE. For Class A fires, some extinguishants to use are water, or water base, foam, loaded steam, or multipurpose dry chemicals.

8. If you use WATER to put out a Class A fire in wood, paper, or cloth in your workplace, you are _____ the fire.

   a. cooling

   b. smothering

9. If you use multipurpose dry chemicals to put out a Class A fire in wood, paper, or cloth in your workplace, you are _____ the fire.

   a. cooling

   b. smothering

10. Saying that you can extinguish Class A fires with water, foam, loaded steam, or multipurpose dry chemicals, is an example of classifying fires on the basis of which of the following:

    a. the material that is burning

    b. what it takes to put the fire out

This is what the OSHA Standards say about the selection of extinguishers for Class A fire hazards: "Extinguishers for protecting Class A hazards shall be selected from among the following: foam, loaded steam, multipurpose dry chemical, and water types." (Section 1910.157(b)(2)(ii).)

FLAMMABLE LIQUIDS

FLAMMABLE LIQUID AND GAS FIRES, SUCH AS OIL, GASOLINE, PAINT, AND GREASE, ARE "CLASS B" FIRES. If a fire develops in a small liquid solvent dip tank in your workplace, this is a Class B fire.

11. Saying that Class B fires are fires in liquids, grease, oil, paint, and gases is an example of categorizing fires on the basis of which of the following:

    a. the material that is burning

    b. what it takes to put the fire out

ANSWERS TO QUESTIONS:

8. a.

9. b.

10. b.

11. a.

EXTINGUISHANTS FOR CLASS B FIRES

If you have TO PUT OUT A CLASS B FIRE IN YOUR WORKPLACE, SOME OF THE EXTINGUISHANTS YOU CAN USE ARE: "CARBON DIOXIDE," "FOAM," "DRY CHEMICALS," "MULTIPURPOSE DRY CHEMICALS," or "LOADED STEAM."

12. Saying that Class B fires in your workplace can be extinguished by CARBON DIOXIDE, FOAM, DRY CHEMICALS, MULTIPURPOSE DRY CHEMICALS, or LOADED STEAM, is an example of categorizing fires on the basis of which of the following:

    a. the material that is burning

    b. what it takes to put the fire out

THE FEDERAL STANDARDS FOR OCCUPATIONAL SAFETY AND HEALTH

THIS IS WHAT THE OSHA STANDARDS SAY ABOUT SELECTING EXTINGUISHERS FOR CLASS B FIRES: "Extinguishers for protection of Class B hazards shall be selected from the following: bromotrifluoromethane, carbon dioxide, dry chemical, foam, loaded steam, and multipurpose dry chemicals," Section 1910.157(b)(2)(iii).

When a fire occurs, it is actually the vapor-air mix above the combustible material that is burning. For example, in the case of a Class B fire in a liquid or grease in your workplace, it is actually the vapor-air mix above the liquid or grease that is burning. When you use a CARBON DIOXIDE (CO_2) fire extinguisher to spray this kind of fire, the CO_2, which is a gas, combines with the vapor-air mix and dilutes the amount of oxygen in the mix. This dilution of oxygen makes the fire go out. When you put out a Class B liquid or grease fire in this way, you are reducing the amount of oxygen available to the fire.

13. WHEN YOU EXTINGUISH A CLASS B FIRE IN A LIQUID OR GREASE BY APPLYING DRY CHEMICALS, you are _____ the fire.

    a. cooling

    b. smothering

YOU CAN ALSO PUT OUT A CLASS B FIRE IN A LIQUID OR GREASE BY SPRAYING IT WITH FOAM. When you extinguish a fire in this way, you are cooling AND smothering it.

ANSWERS TO QUESTIONS:

12. b.

13. b. Smothering. The dry chemicals exclude oxygen from the fire and smother it.

---

14. When you put out a Class B fire in liquid or oil by smothering it with DRY CHEMICALS, you are reducing the amount of _____ available.

    a. heat

    b. fuel

    c. oxygen

WOOD, PAPER, OR RAGS

15. If you have a fire in wood, paper, or rags in your workplace, it is a Class _____ fire.

    a. A

    b. B

LIQUID, OIL, OR GREASE

16. If you have a fire in liquid, oil, or grease in your workplace, it is a Class _____fire.

    a. A

    b. B

17. Which of the following would you NOT use to put out most Class A fires in wood, paper, or cloth?

    a. water

    b. foam

    c. carbon dioxide

18. Which of the following would you NOT use to put out a Class B fire in liquid, oil, or grease?

    a. water in liquid form

    b. foam

    c. carbon dioxide

    d. dry chemicals

ANSWERS TO QUESTIONS:

14. c.

15. a.

16. b.

17. c. Carbon Dioxide. Carbon dioxide should only be used for very small, incipient Class A fires.

18. a. Water in liquid form. Using water in liquid form on a Class B fire can scatter the flame and spread such a fire. However, water in the form of fog has proved to be effective where the fire is confined and is not an extensive spill type of fire.

FOR CLASS A OR CLASS B FIRES?

19. Label the extinguishants below as to whether you would use them for Class A or Class B fires, or both:

    a. water in liquid form _____

    b. foam _____

    c. carbon dioxide _____

    d. dry chemicals _____

    e. multipurpose dry chemical _____

IF THERE IS A FIRE IN ENERGIZED ELECTRICAL EQUIPMENT IN YOUR AREA, IT IS CALLED A CLASS C FIRE. ("Energized" means the equipment is still receiving electricity from the electrical power supply.) These kinds of fires are tricky to put out until the electrical equipment is disconnected or the power supply is interrupted, because there is the risk of a firefighter, machine operator, or observer being shocked or electrocuted. For this reason you would not use water in liquid form on an electrical equipment fire in your workplace until the equipment is disconnected or the power supply interrupted because a straight stream of water conducts electricity back to the firefighter or other personnel in the vicinity. However, water in the form of fog is a nonconductor and can be used within two feet of electrical gear.

20. If a fire breaks out in an energized electric generator in your workplace, this would be a Class _____ fire.

    a. A

    b. B

    c. C

21. You would fight a Class C fire in energized electrical equipment with extinguishants that conduct electricity.

    a. do

    b. do not

ANSWERS TO QUESTIONS:

19. a. A b. A & B c. B d. B e. A & B

20. c. C. The fire would be a Class C fire because the electric generator is receiving power from the electrical power supply.

21. b. Do not. If an extinguishant that conducts electricity is used, there is danger of severely shocking or electrocuting personnel in the area.

If you have a Class C electrical equipment fire in your workplace, some extinguishants you can use are: CARBON DIOXIDE, DRY CHEMICALS, or MULTIPURPOSE DRY CHEMICALS. You use the carbon dioxide to reduce the amount of oxygen in the air. You use the dry chemicals or multipurpose dry chemicals to smother the fire. These extinguishants do not conduct electricity so they are safe to use on Class C fires involving electricity.

22. Saying that you can extinguish a Class C fire in your area with CARBON DIOXIDE, DRY CHEMICALS, or MULTIPURPOSE DRY CHEMICALS, is an example of categorizing fires on the basis of which of the following:

    a. the material that is burning

    b. what it takes to put the fire out

This is what the OSHA Standards say about selecting extinguishers for Class C hazards: "Extinguishers for protection of Class C hazards shall be selected from the following: bromotrifluoromethane, carbon dioxide, dry chemical, and multipurpose dry chemical." Section 1910.157(b)(2)(iv).

When you put out a Class C fire in energized electrical equipment by diluting the oxygen in the air with CARBON DIOXIDE or by smothering the fire with DRY CHEMICALS or MULTIPURPOSE DRY CHEMICALS, you are reducing the oxygen available to the fire.

As soon as you have extinguished the fire, be sure to disconnect the electrical equipment or interrupt the power supply to avoid another fire caused by the same short circuit or other condition that caused the fire you just put out. Only reconnect the electrical equipment after you have discovered and eliminated the cause of the fire.

THE ONLY THING THAT MAKES A CLASS C FIRE DIFFERENT FROM A CLASS A OR B FIRE IS THE FACT THAT ELECTRICITY IS INVOLVED. If you have to fight a fire in equipment receiving power from the electrical power supply, you have to use one of the extinguishing agents that does not conduct electricity. However, IF YOU CAN MANAGE TO DISCONNECT THE EQUIPMENT FROM THE POWER SUPPLY OR TURN OFF THE POWER SUPPLY, THEN YOU CAN FIGHT THE FIRE AS IF IT WERE A CLASS A OR B FIRE, depending on what else is burning. This means that disconnecting electrical equipment turns a Class C fire into a Class A or B fire, depending on what is burning.

23. Once the electrical equipment is de-energized or the power source is interrupted in a Class C fire, apply a smothering or cooling extinguishant as with a Class _____ or Class _____ fire.

    a. Class A

    b. Class B

    c. Class C

ANSWERS TO QUESTIONS:

22. b.

23. a. Class A b. Class B
As soon as you are able to disconnect electrical equipment or interrupt the power supply, the danger of severe shock or electrocution is eliminated. Then you no longer have to use an extinguishant that does not conduct electricity.

---

24. A FIRE IN METAL OR METALLIC DUST IS A CLASS D FIRE. Putting out a Class D fire is tricky because there is the chance of a dangerous chemical reaction between some of the commonly used extinguishants and the burning metal. Putting water on burning magnesium, for example, will cause an EXPLOSION. This means that if you use the wrong extinguishant, it can make a Class D fire _____ .

    a. worse

    b. go out

25. Saying that a Class D fire is a fire in METAL is an example of categorizing fires on the basis of which of the following?

    a. the material that is burning

    b. what it takes to put the fire out

Operations involving metals which are in a very hot liquid state require additional safeguards. If these molten metals splatter or splash, they might provide a source of heat to ignite other nearby combustible materials.

THIS IS WHAT THE OSHA STANDARDS SAY ABOUT SELECTING EXTINGUISHERS FOR CLASS D HAZARDS: "Extinguishers and extinguishing agents for the protection of Class D hazards shall be of types approved for use on the specific combustible-metal hazard." Section 1910.157(b)(2)(v).

FIGHTING CLASS D FIRES IN METALS REQUIRES A SPECIFIC CHEMICAL FOR EACH SPECIFIC METAL. This means that deciding what extinguishant to use on a particular Class D fire is not simple. This is a decision that should be made by a fire protection specialist.

To prepare yourself for fighting a Class D fire that might break out in your workplace, you would do the following things:

- make a list of the metals in your workplace
- find out which ones will burn
- find out what specific chemical extinguishant to use for each specific burnable metal on your list.

ANSWERS TO QUESTIONS:

24. a. Worse. The wrong extinguishant on burning metal may spread the fire or make it burn more fiercely.

25. a.

---

26. To be sure you have available the specific chemical which should be used for a specific metal that might be involved in a Class D fire in your workplace, which of the following would you NOT do?

    a. consult your company safety or fire protection specialist, if you have one

    b. refer to National Fire Safety Association publications

    c. consult your employer's insurance carrier

    d. rely on your own knowledge

27. Class _____ fires are fought with heat-absorbing chemicals that do not react with burning metals.

    a. Class A

    b. Class B

    c. Class C

    d. Class D

28. Label the following materials as to whether they are involved in Class A, B, C, or D fires.

    a. metals _____

    b. energized electrical equipment _____

    c. wood, paper, cloth _____

    d. liquids, oil, grease _____

29. Label the fire extinguishants below as to whether you would use them in a Class A, B and/or C fire.

    a. water in liquid form _____

    b. foam _____

    c. carbon dioxide _____

    d. dry chemicals _____

ANSWERS TO QUESTIONS:

26. d. Don't rely on your own knowledge; in this situation only experts can tell you what to do.

27. d.

28. a. D b. C c. A d. B

29. a. A b. A & B c. B & C d. B & C

---

30. Almost all workplaces have some of the following hazards:

- paper
- wood desks, tables, chairs, benches
- cloth in rags, furniture, curtains, carpets
- paper and wood packing materials
- trash

If your workplace has any of the above items, this means you need a fire extinguishant for Class _____ hazards.

a. A

b. B

c. C

d. D

31. Many operations use flammable liquids or oils. If yours does, this means you need a fire extinguishant for Class _____ hazards.

a. A

b. B

c. C

d. D

32. Many operations use electric motors in the workplace to run equipment or machinery. If yours does, this means you need a fire extinguishant for Class _____ hazards.

a. A

b. B

c. C

d. D

ANSWERS TO QUESTIONS:

30. a.

31. b.

32. c.

CLASS A, B, AND C HAZARDS

33. If you have Class A, Class B, and Class C fire hazards in your workplace, this means you need a fire extinguishant for how many different classes of fires?

ONE EXTINGUISHANT OR SEVERAL?

34. If you need a fire extinguishant for more than one class of fire, could you do either of the following?

    a. keep on hand a different fire extinguishant for each class of fire hazard in your workplace

    b. select a single type of fire extinguishant that can be used for more than one class of fire

35. THERE IS ONE TYPE OF FIRE EXTINGUISHANT THAT YOU CAN USE ON CLASS A, CLASS B, AND CLASS C FIRES. Pick it out from the list below:

Extinguishant	*Class of Fire*
a. foam	A & B
b. water base	A
c. carbon dioxide	B & C
d. dry chemical	B & C
e. multipurpose dry chemical	A, B & C

When you choose new fire protection equipment or evaluate the adequacy of existing equipment, you need to take into account HOW BIG a fire in your area is likely to be. The POTENTIAL SIZE of a fire in your workplace is related to the QUANTITY OF BURNABLE MATERIAL that is present. The LESS burnable material you have in your workplace, the smaller the fire hazard (other things being equal). The MORE burnable material in your workplace, the greater the fire hazard (other things being equal).

ANSWERS TO QUESTIONS:

33. three

34. a. Yes b. Yes
You could do either, but selecting a multipurpose extinguishant might be simpler.

35. e.

THE OSHA STANDARDS DIVIDE HAZARDS BASED ON SIZE OF FIRE INTO THE THREE CATEGORIES SHOWN BELOW (Section 1910.157(c)(3)(Table L-2):

OSHA Standard Hazard Category	
Light	Small amount of burnable material present
Ordinary	Ordinary amount of burnable material present
Heavy	Extra amount of burnable material present

Business offices, classrooms, and telephone exchanges, for example, usually are classified as LIGHT hazard areas because the quantity of combustible materials on their premises is SMALL. Washrooms and auditoriums are likely to be classified as LIGHT hazard areas for the same reason. The SMALL amount of combustible materials present in the light hazard areas in the examples would mean that any fire that occurred would probably be relatively small.

Some manufacturing plants, most department store storage and display areas, and some types of warehouses are classified as ORDINARY hazard areas because the quantity of combustible materials on their premises is neither small nor extra large but ORDINARY or average. A small printing shop is likely to be classified as an ORDINARY hazard for the same reason. The ORDINARY or average amount of combustible material present in the ORDINARY hazard areas in the examples would mean that any fire that occurred probably would NOT be large.

Woodworking areas and warehouses with high stacks of combustibles are classified as HEAVY hazard areas because of the presence of EXTRA LARGE quantities of burnable materials. Auto repair and aircraft servicing areas would be classified as HEAVY hazards for the same reason. The EXTRA amount of combustible materials present in the HEAVY hazard areas in the examples would mean that any fire that occurred would very likely be serious.

Areas where processes such as flammable liquid handling are carried out are also classified as HEAVY hazard areas because of the presence of EXTRA large quantities of combustible materials. A spray painting area would be classified as a heavy hazard for the same reason.

IT IS VERY IMPORTANT TO KNOW THAT YOU HAVE THE RIGHT TYPE AND SIZE EXTINGUISHER FOR THE TYPE OF FIRE AT HAND. The National Fire Protection Association Inspection Handbook suggests that portable fire extinguishers be evaluated by checking certain factors:

- the suitability of the types of extinguishers furnished to cope with the kind of fires anticipated in the workplace protected;
- the total number of extinguishers provided and their capacities to cope with the severity of fires anticipated;
- location and accessibility of the extinguishers to permit prompt use;
- the adequacy of maintenance facilities provided or available for proper charging, cleaning and repair of extinguishers;
- the extent to which employees who may be called upon to use the extinguishers have received instruction in their use and opportunities to practice such use.

WHAT YOU NEED TO KNOW

You have already learned three things you need to know to select the right kind of portable fire extinguishers for your area or to evaluate the adequacy of the ones you already have:

- what Class A, B, C, and D fires are;
- when to use water, foam, carbon dioxide, dry chemicals, and multipurpose dry chemical extinguishants;
- what light, medium, and extra fire hazard situations are.

Two additional things you need to know are:

- what size extinguishers you need;
- how many extinguishers you need.

FOR CLASS A FIRES

PORTABLE FIRE EXTINGUISHERS FOR CLASS A FIRES ARE IDENTIFIED WITH THE LETTER "A" AND A NUMBER. THE "A" INDICATES THAT THE EXTINGUISHER IS FOR FIRES IN ORDINARY COMBUSTIBLES LIKE WOOD, PAPER, AND CLOTH. THE NUMBER TELLS THE RELATIVE EXTINGUISHING POTENTIAL of the fire extinguisher.

36. The 1A unit has the smallest capacity. The 2A unit will extinguish twice as much fire as the 1A unit. 3A units will extinguish three times as much fire as a 1A unit. A 6A fire extinguisher will extinguish _____ times as much fire as a 1A unit.

ANSWERS TO QUESTIONS:

36. six

THE OSHA STANDARDS

THE OSHA STANDARDS SPECIFY THE SIZE AND PLACEMENT OF EACH CLASS OF PORTABLE FIRE EXTINGUISHERS. THE SIZE OF CLASS A EXTINGUISHERS YOU NEED DEPENDS ON THE SIZE OF YOUR WORK AREA AND THE AMOUNT OF COMBUSTIBLE MATERIAL PRESENT. Table L-1, from the OSHA Standards, shows the requirements for Class A extinguishers, (CFR 1910.157(c)(2)(Table L-1).). Take a look at Table L-1, on the following page, and answer some questions about it. As you can see from this table, for 3,000 square feet of work area where you have a LIGHT hazard situation, you need an extinguisher with a 1A rating.

37. What extinguisher rating do you need for 3,000 square feet in an ORDINARY hazard area?

38. What extinguisher rating do you need for 3,000 square feet in an EXTRA hazard area?

TABLE L-1

Extinguisher Rating	Travel Distance to Extinguishers (feet)	Area per Extinguisher		
		Light Hazard (sq. ft.)	Ordinary Hazard (sq. ft.)	Extra Hazard (sq. ft.)
1A	75	3,000	-	-
2A	75	6,000	3,000	-
3A	75	9,000	4,500	3,000
4A	75	11,250	6,000	4,000
6A	75	11,250	9,000	6,000

(CFR 1910.157(c)(2)(Table L-1).)

Portable fire extinguishers for CLASS B fires are identified with the letter "B" and a number. The "B" indicates that the extinguisher is for fires in flammable liquids, solvents, paint, oil, grease, and gases. The number tells the extinguishing potential of the fire extinguisher. A 4B unit will extinguish 4 square feet of fire on the surface of a tank of flammable liquid. An 8B unit will extinguish 8 square feet of a similar fire.

39. A 12B unit will extinguish _____ square feet of a similar fire.

The size of Class B portable fire extinguisher you need depends on the AMOUNT OF COMBUSTIBLE MATERIAL PRESENT in your work area. Table L-2 from the OSHA Standards shows the minimum requirements for Class B fire extinguishers. Take a look at this table on the following page.

40. According to Table L-2 below, what extinguisher rating do you need for a LIGHT hazard area for Class B fires?

41. For an ORDINARY hazard area?

42. For an EXTRA hazard area?

ANSWERS TO QUESTIONS:

37. 2A

38. 3A

39. 12

40. 4B

41. 8B

42. 12B

TABLE L-2

Type of Hazard	Extinguisher Rating	Travel Distance to Extinguishers (feet)
Light Hazard	4B	50
Ordinary Hazard	8B	50
Extra Hazard	12B	50

(CFR 1910.157(c)(3)(Table L-2).)

THIS IS WHAT THE OSHA STANDARDS SAY ABOUT THE SIZE OF FIRE EXTINGUISHERS FOR CLASS B FIRES IN FLAMMABLE LIQUIDS DEEPER THAN 1/4-INCH: "For flammable liquid hazards of appreciable depth (Class B), such as in dip quench tanks, Class B fire extinguishers shall be provided on the basis of one numerical unit of Class B extinguishing potential per square foot of flammable liquid surface of the largest tank hazard within the area," (Section 1910.157(c)(4).).

Portable fire extinguishers for CLASS C fires are identified with the letter "C." The "C" indicates that the extinguisher is for fires involving energized electrical equipment. Class C fire extinguishers do not have numbers to show extinguishing capacity.

THIS IS WHAT THE OSHA STANDARDS SAY ABOUT SIZE AND PLACEMENT OF FIRE EXTINGUISHERS FOR CLASS C FIRE HAZARDS: "Extinguishers with Class C ratings shall be required where energized electrical equipment may be encountered which would require a nonconducting extinguishing media. This will include fire either directly involving or surrounding electrical equipment. Since the fire itself is a Class A or Class B hazard, the extinguishers are sized and located on the basis of the anticipated Class A or B hazard." (Section 1910.157(c)(5)(i).)

Portable fire extinguishers for Class D fires in metals are identified with the letter "D." Class D fire extinguishers do not have numbers to show extinguishing capacity and are intended for special hazard protection only.

43. Once you determine that you have the right kind, size and quantity of portable fire extinguishers for your work area, you need to be sure they are immediately available in the event of a fire. Does this mean they should be:

	Yes	*No*
a. easily seen	_____	_____
b. easily reached	_____	_____
c. fully charged and operable	_____	_____
d. conspicuously marked as to class of fire	_____	_____
e. stored in a warehouse	_____	_____
f. inspected only once every five years	_____	_____

For more information about installation of portable fire extinguishers, get a copy of National Fire Protection Association Standard No. 10-1970, "Standard for Installation of Portable Fire Extinguishers." The address of the NFPA appears in Lesson 14.

WHEELED EXTINGUISHERS

In a big work area, you may need a greater volume of extinguishant than several hand-portable extinguishers can provide. In this case, a wheeled extinguisher may be necessary. A foam-type wheeled unit, for example, may have a large storage tank holding 40 gallons. These extinguishers are best operated by more than one man and should be narrow enough to roll in aisles and through doorways.

KNOW HOW TO USE AN EXTINGUISHER

Besides knowing what kind of fire extinguishers to use on each type of fire, you and the employees you supervise need to know HOW and WHEN to use the extinguishers. Here is an illustration of what can happen if someone doesn't know how to use a fire extinguisher:

An employee in a woodworking shop noticed a small fire in a pile of shavings. He took a fire extinguisher from where it was hanging on the wall and put it over his shoulder to carry it to the scene of the fire. The extinguisher was the soda-acid type and, as soon as it was put in a horizontal position over his shoulder, the soda and acid mixed together. The resulting pressure expelled all the contents from the extinguisher before the employee could get to the scene of the fire. The fire spread rapidly and had to be put out by the Fire Department. Luckily, no one was hurt, but the shop had to be shut down for four days while the damage was repaired. If the employee had known how to use the fire extinguisher, there is a good chance he could have put out the fire while it was still small. You should make it part of your job to train your employees in the proper use of the fire extinguishers in your workplace.

The OSHA Standards require that all PORTABLE extinguishers be inspected at least ONCE A MONTH, (Section 1910.157(d)(2)(i).):

- to insure that they are in their designated places;
- to insure that they have not been actuated;
- to detect any visible physical, corrosion, or other impairments.

ANSWERS TO QUESTIONS:

43. a. Yes b. Yes c. Yes
d. Yes e. No f. No

The OSHA Standards also require that all PORTABLE extinguishers receive the following maintenance at least ONCE A YEAR to assure operability and safety, (Section 1910.157(d)(3).):

- thorough examination;
- recharging,
- repair, indicated by the examination.

A durable tag shall be securely attached to show the maintenance or recharge date and the initials or signature of the person who performs this service.

44. Indicate which inspection and maintenance tasks below should be performed on portable fire extinguishers at least monthly and which at least yearly, according to the OSHA Standards.

	At Least Monthly	*Yearly*
a. thorough examination and repair as indicated by the examination	_____	_____
b. inspection to detect visible damage or corrosion	_____	_____
c. periodic recharging	_____	_____
d. inspection to determine extinguishers are in their proper places	_____	_____
e. inspection to detect tampering or actuation	_____	_____

FOR MORE INFORMATION

For more information about operation, inspection, test, and maintenance of portable fire extinguishers, get a copy of NFPA Code No. 10A-1970, "Maintenance and Use of Portable Fire Extinguishers."

You probably will not be involved in selecting or evaluating the adequacy of fixed fire suppression equipment for your workplace. IF YOU HAVE A FIXED SYSTEM IN YOUR AREA, WHAT YOU NEED TO KNOW ABOUT IT IS:

- how the system works so you can get the best use out of it in case of fire;
- how to deal with an automatic system that is inadvertently activated so you can minimize damage to the premises from the extinguishing agent.
- how and when to shut the system off after a fire or for maintenance (if a fire protection expert is not available to do so).

ANSWERS TO QUESTIONS:

44. a. Yearly b. Monthly c. Yearly
d. Monthly e. Monthly
Of course, extinguishers also require recharging after each use.

The most common type of fixed fire extinguishing system is the fixed pipe system. These systems normally have:

- a supply of extinguishant;
- piping to deliver the extinguishant;
- an actuating device;
- an alarm.

Some types of extinguishants used in fixed pipe systems are:

- water;
- foam;
- carbon dioxide;
- dry chemicals.

45. Would it be correct to say that fixed pipe systems exist for Class A, B, and C fires?

a. Yes

b. No

WATER IS THE EXTINGUISHANT MOST OFTEN USED IN FIXED PIPE SYSTEMS. Supervisor A has an automatic sprinkler system in his workplace which has piping close to the ceiling and sprinkler heads spaced along the pipes. The sprinkler heads operate at a predetermined fixed temperature to release the water.

46. Would it be correct to say that this system is designed so that a fire turns on the water and puts itself out?

a. Yes

b. No

47. Below is a list of THINGS TO DO and THINGS NOT TO DO to assure getting full benefit from an automatic sprinkler system at the time of a fire. For each one, indicate whether it is a "do" or a "don't."

a. pile stock too close to the sprinkler heads _____

b. keep sprinkler heads clean and free of corrosion and paint _____

c. protect floor openings to prevent drafts of hot air that could activate sprinkler heads on a floor remote from a fire _____

ANSWERS TO QUESTIONS:

45. a.

46. a.

47. a. Don't. If material is stacked too close to the sprinkler heads, it may divert the water spray from the fire or prevent the fuse from being melted to activate the system.
b. Do. If the sprinkler heads are corroded or paint-clogged, they won't sprinkle properly.
c. Do. You don't want water sprinkling on a floor where there is NO fire; you need all the water where the fire is.

You may have to shut off an automatic sprinkler system after a fire. Before shutting off the system, be sure the fire is completely extinguished. This is important because, if the fire should rekindle, there would be no water immediately available to put it out again. Other than after a fire, another occasion to shut off a sprinkler system is for replacement of a broken or fused sprinkler head or for repair of a part of the system.

48. Which of the following are legitimate occasions for shutting off an automatic sprinkler system?

	Yes	*No*
a. after the system has been activated by a fire and the fire has been put out	____	____
b. when a part is broken	____	____
c. when someone wants to pile material up to the ceiling	____	____

Additional information about sprinkler systems appears in NFPA Code No. 13-1969, "Standard for the Installation of Sprinkler Systems."

49. Another common extinguishant used in fixed pipe systems is carbon dioxide. Fixed carbon dioxide systems are used to protect against fires in such things as flammable liquid dip tanks, paint spray booths, and electrical equipment. What two classes of fires are these carbon dioxide systems used for? _____ _____

50. Fixed pipe dry chemical systems are used to protect against fires in such things as restaurant kitchen range hoods, ducts, and over deep fat fryers. What class of fire are these dry chemical systems for? _____

The OSHA Standards require that all fixed dry chemical and carbon dioxide systems be inspected at least once a year. The standards also require that the extinguishing agent pressure containers be inspected at least every six months. (Section 1910.160(c).) Match the items in Column A below with the inspection requirements in Column B.

A. Item		*B. Inspection Required*
51. entire fixed system	_____	a. at least semi-annually
52. extinguishant pressure container	_____	b. at least annually

ANSWERS TO QUESTIONS:

48. a. Yes b. Yes
c. No. Don't let them do it or there may be nothing left to stack up.

49. B and C

50. B

51. b. 52. a.
These inspection requirements are important; the best fixed system isn't good enough if it doesn't work when needed.

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53. Exposure of personnel to carbon dioxide or dry chemicals may be harmful. Does this mean that, if you have a fixed fire extinguishing system in your workplace which uses either of these two extinguishing agents, there is a potential danger to the employees working there?

    a. Yes

    b. No

One way to avoid exposing the employees you supervise, or yourself, to hazards from carbon dioxide or dry chemicals used to extinguish a fire, is to arrange for FAST evacuation of your workplace in case the fixed fire extinguishing equipment is activated.

The OSHA standards require that arrangements be made for fast evacuation and suggest such safety items as: 1) predischarge signals; 2) discharge signals; 3) warning signs; 4) personnel training; and 5) breathing apparatus. (Section 1910.161(a)(2).). An alarm that sounds BEFORE dry chemicals are discharged is a PRE-discharge signal. An alarm that sounds DURING THE time carbon dioxide is being discharged is a discharge signal.

54. If there is any type of fixed fire extinguishing equipment in your plant, either automatic or manual, which one of the following should you, as the supervisor, NOT do?

    a. find out what kind of system it is

    b. alert the employees you supervise about the hazards and benefits of the system

    c. assist with or encourage initiation of a training program concerning the system

    d. discuss the features of the system in your safety contracts

    e. decide that the subject is too complicated for you to understand

ADDITIONAL INFORMATION

Additional information can be obtained from: NFPA Code No. 12-1968 "Standard on Carbon Dioxide Extinguishing Systems," and NFPA Code No. 17-1969, "Standards for Dry Chemical Extinguishing Systems."

ANSWERS TO QUESTIONS:

53. a. Yes. It seems like a paradox to say that protecting against a safety hazard can create a health hazard, but that's what can happen if precautions aren't taken.
54. e. You don't have to be a fire protection expert to perform the supervisory functions listed above.

Among the most common causes of industrial fires are the following:

- smoking and matches
- electrical
- rubbish, source of ignition unknown
- flammable liquid fires
- open flames and sparks
- spontaneous ignition
- gas fires and explosions

You will note that the fire cause at the top of the list in above item is "Smoking." There are various ways to combat this problem, depending on the circumstances. One rule of thumb is that it is better to allow smoking in a supervised location where it can be supervised than to try to prevent it altogether. In extra hazard areas such as woodworking shops and textile mills where smoking should be prohibited, a special enclosed or removed area can be set aside to allow smoking. Supervisor A works in a flour mill and Supervisor B in a grain elevator, both high hazard areas. Supervisor A forbids his employees to smoke at all. Supervisor B permits smoke breaks in a special fire safe room.

55. Which one has a better chance of preventing a fire caused by a carelessly discarded cigarette or match?

a. Supervisor A

b. Supervisor B

In areas where careful smoking is permissible, a way to deal with the hazard of careless smoking is to provide sufficient ashtrays of good design. Supervisor A has an ashtray like the one on the next page for each smoker in the area. Supervisor B's employees put their cigarettes out on the floor or throw them in an ordinary waste can.

56. Which supervisor is more likely to have a fire in his area caused by careless smoking?

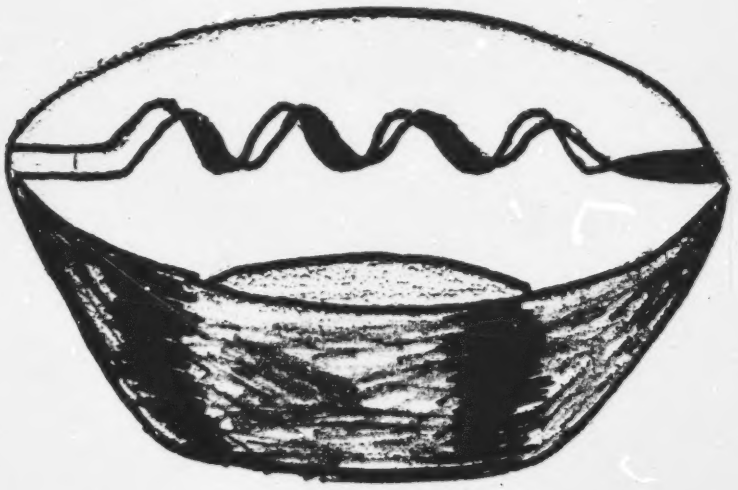
a. Supervisor A

b. Supervisor B

ANSWERS TO QUESTIONS:

55. b. Supervisor B. When employees who work in a hazardous area can smoke in a special place, they are much less likely to break the rules about not smoking where it can cause a fire.

56. b. Supervisor B. Note that the well-designed ashtray will keep ashes, cigarette butts and matches INSIDE instead of letting them fall into the workplace.



Typical *well-designed ash tray* that keeps ashes and cigarette butts contained within the receptacle

Poor housekeeping is the basic cause of many industrial fires. For example, oil soaked rags, paint rags, and polishing cloths are likely to be ignited through spontaneous combustion if not stored in the right kind of waste cans. Supervisor A does the following things: 1) uses noncombustible waste cans with self-closing covers (see the next page), and 2) has the waste cans removed daily. Supervisor B's employees store their rags in a wood cabinet in their workplace.

57. Which supervisor has a better chance of avoiding a fire from spontaneous combustion?

    a. Supervisor A

    b. Supervisor B

Both Supervisor A and Supervisor B work in areas where the employees they supervise use cleaning solvents. Supervisor A uses the type of dispenser and storage can designed to control vapor and keep fire out (see the following page). Supervisor B's employees keep their solvent in old oil drums.

58. Which supervisor is more likely to have a Class B fire in the workplace?

    a. Supervisor A

    b. Supervisor B

ANSWERS TO QUESTIONS:

57. a. Supervisor A. The foot-operated and self-closing features of the well-designed waste can make its use convenient and thus encourage employees to use it. The self-closing feature also has a safety purpose, as does the noncombustible feature.

58. b. Supervisor B. Note that the design of the dispenser and storage can minimizes spillage and evaporation.

Typical well-designed safety storage can with fire baffle located in the spout that prevents the propagation of fire within the container.

Typical well-designed foot-operated waste can

If housekeeping is inadequate, combustible trash and litter can accumulate rapidly and cause a condition which could result in a fire. Supervisor A has the employees he supervises clean the oil and trash from the pits under their machines every MONTH or so. Supervisor B has the employees she supervises remove dust and lint from around the conveyors, belts, and motors on their machines every couple of WEEKS. Supervisor C has the employees he supervises wipe up oil and solvent spills whenever they occur and clean up the work area DAILY, including emptying waste receptacles.

59. Which supervisor has the best chance of avoiding a fire in the workplace caused by poor housekeeping? _____

It is poor housekeeping practice to allow excess hazardous work material to accumulate. Supervisors A and B have just been hired to work in a large automobile body repair and paint spraying shop. The first day on the job, Supervisor A discovers that in his area the employees are permitted to smoke. Supervisor B notices that in his area there is at least a week's supply of paint, lacquer, and thinner lying around. They get together at lunch, and afterwards each one goes back to his work area and takes a safety action.

60. Which supervisor took which action?

    a. Supervisor _____ tells the employees he supervises to keep out enough paint, lacquer, and thinner for the afternoon's work and to put the rest away in an approved metal cabinet remote from the spraying operation. He is removing the _____before a fire can occur.

    b. Supervisor _____ tells the employees he supervises that there is to be no more smoking on the job. He arranges for them to use a fireproof room in a nearby area for smoke breaks. He is removing the _____ before a fire can occur.

61. Supervisor C comes back from a safety training course and realizes that the accumulation of wood shavings and sawdust everyone steps over every day in the woodworking shop is a fire hazard. All employees are instructed to begin a daily housekeeping routine, including removal of the shavings and sawdust. By starting the housekeeping routine, Supervisor C is removing the _____ before a fire can occur.

    a. heat

    b. oxygen

    c. fuel

62. Supervisor C conducts a course of instruction for employees about how to fight the type of fire that might occur in the woodworking shop:

    a. This would be a Class ____ fire

    b. One of the fire-fighting instructions Supervisor C gives employees is to _____ any such fire by using _____ .

    - cool
    - water
    - smother
    - carbon dioxide

ANSWERS TO QUESTIONS:

59. Supervisor C. OSHA standards deal with housekeeping in several places; one is section 1910.22.

60. a. Supervisor B. Fuel, the paint, lacquer, and thinner are all very flammable.
b. Supervisor A. Heat, smoking in a paint spraying area is really asking for trouble.

61. c. Fuel. Habit can make people careless; take a sharp look at your workplace for hazards you may be overlooking because you have become used to them.

62. a. Class A b. cool water

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63. Supervisor D arrives to take charge of a small garment factory her employer has just acquired. She observes that there is loose, open, and frayed wiring on the sewing machines and irons the employees are using. She also notices that there is a large amount of cloth, scraps, thread, and lint around. There are some serious fire hazards in this garment factory.

a. Is one of the fire hazards a source of heat and ignition? Yes___ No___

If so, what is it?

b. Is there a large quantity of combustible fuel on the premises? Yes___ No___

If so, what is it?

Supervisor D recognizes that the frayed wiring in the garment factory is a safety and fire hazard. She also recognizes that the BASIC CAUSE of this problem is inadequate maintenance and inadequate facility inspection. When wiring becomes frayed and is not repaired, this is an indication that the factory's equipment is not being properly maintained. It is also an indication that regular inspections are either not being made or are failing to detect a hazardous condition.

64. Supervisor D conducts a complete facility inspection and tags all the unsafe wiring for immediate repair or replacement. She instructs that none of the defective equipment be used until it is repaired and arranges for maintenance personnel to come in over the weekend to repair or replace the wiring. By this action, she is removing the _____ before a fire can occur.

a. heat

b. fuel

c. oxygen

Supervisor D recognizes that the accumulation of cloth, scraps, thread, and lint in the garment factor is a fire hazard. She also recognizes that the BASIC CAUSE of this problem is inadequate housekeeping and inadequate facility inspection. Any time such flammable byproducts as cloth and thread scraps and lint are allowed to accumulate in a workplace, this is an indication of poor housekeeping; it also means that the area is NOT being regularly inspected or that the inspector is doing a sloppy job.

ANSWERS TO QUESTIONS:

63. a. Yes. Irons and unsafe electrical wiring.
    b. Yes. Cloth, scraps, thread, and lint.

64. a. Heat. Unsafe electrical wiring always has the potential of igniting a fire, especially where such combustible fuel as clothing fabrics and lint are nearby.

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65. After Supervisor D conducts a facility inspection, she instructs that the entire area be thoroughly cleaned to remove all fabric and thread scraps and lint from the floor and machines. She arranges to get noncombustible waste containers for fabric and thread scraps. She establishes a daily routine for cleaning lint and scraps from the workplace and the machines. She arranges for a storage area for fabrics not needed during the day's operation. When she does all these things, Supervisor D is removing the _____ from the fire triangle before a fire can occur.

    a. fuel

    b. heat

    c. oxygen

Before she begins any of her safety activities such as the facility inspection, the maintenance orders, or the housekeeping orders, Supervisor D arranges a meeting with the employees she supervises so that she can COMMUNICATE to them that she is concerned about reducing the threat to their well-being from fire, so that she can EDUCATE them about the fire hazards that exist, and so that she can MOTIVATE them to help to eliminate hazards. When Supervisor D does these things, she is performing the safety and health communication/motivation part of a supervisor's job about which you will hear more in the next lesson.

66. Supervisor D arranges to teach the employees she supervises about the classes of fire that might occur in the garment factory and WHAT EXTINGUISHANTS TO USE in fire fighting. Because there is a lot of electrical equipment and machinery in the garment factory, a fire here would probably be a Class _____ fire.

    a. A

    b. B

    c. C

    d. D

67. In case of fire in the garment factory, after the electrical equipment was disconnected or the electrical power source interrupted, the cloth, lint, and wood work tables that would be burning would be considered a Class _____ fire.

    a. A

    b. B

    c. C

    d. D

ANSWERS TO QUESTIONS:

65. a. Fuel. Since a noncombustible waste container will not burn and will retard ignition of its contents, use of such containers protects such flammable byproducts from burning and also minimizes spreading of fire from one waste container to another.

66. c. Class C fire, because of the energized electrical equipment.

67. a. Class A fire, because the fuel would be ordinary combustible materials, cloth and wood.

The way in which flammable liquids and other combustible materials are stored is important in reducing the hazard of fire. There are many good safety dispensers and containers on the market that have been tested and approved by such recognized laboratories as the Underwriters Laboratories, Inc. For details about approved containers, write to the Underwriters Laboratories at the address given in Lesson 14. Remember that you want the container to be noncombustible and to have dispensing spouts with baffles to prevent fire from getting inside.

Supervisor E is in charge of a machine shop. He has a friend with the same job in another company. One day there is a serious fire in the friend's shop. Supervisor E is concerned that a similar fire might occur in his shop and looks around carefully for hazards. The first thing he sees is that gasoline in an open container is being used as a cleaning and degreasing agent. Supervisor E knows that gasoline is very dangerous to use as a solvent. This is because gasoline gives off hazardous vapor even at a very low temperature - lower than the inside of a home deep freeze; and the vapor can be ignited by a pilot light or spark, for example. He arranges to substitute a less hazardous solvent. Supervisor E should also arrange to have the less hazardous solvent stored in an enclosed dispenser of approved design. The enclosed dispenser will minimize hazardous spilling and evaporation and will also prevent the contents of the dispenser from being ignited.

68. By taking action to reduce the hazard from the cleaning solvent, Supervisor E will remove the _____ before a fire occurs.

    a. fuel

    b. heat

    c. oxygen

THE OSHA STANDARDS

By taking action to reduce the fire hazard from the way the cleaning solvent is handled and stored, Supervisor E will also be complying with the OSHA standards, which say: "Only approved containers and portable tanks shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids," (Section 1910.106(e)(9)(L).).

69. If, in spite of precautions, there should be a flammable liquid fire in Supervisor E's machine shop, what class of fire would it be?

    a. Class A

    b. Class B

    c. Class C

    d. Class D

ANSWERS TO QUESTIONS:

68. a. Fuel. The enclosed dispenser protects the flammable solvent from being ignited.

69. b.

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70. Below are listed two reasons why fires get out of control. In both cases the results are the same - a late alarm which permits the fire to continue long enough to become uncontrolled. Indicate which is the result of lack of equipment and which is the result of lack of training.

    a. there is no adequate alarm system to give warning that a fire has started — • lack of TRAINING

    b. the person who discovers the fire fails to turn in the proper signal — • lack of EQUIPMENT

71. An important fire fighting rule is to give an alarm immediately when a fire is discovered. You should instruct employees to give an alarm right away when they discover even a small fire. Based on this rule, is the following statement correct?

    "It is better to have the fire department respond and find that you have brought the blaze under control than to have them arrive later and find the fire out of control."

    a. Yes

    b. No

72. This is what the OSHA standards say about the LOCATION of local fire alarm signaling systems when this signaling method is used: "Manual fire alarm boxes shall be distributed throughout the protected area so that they are unobstructed, readily accessible, and located in the normal path of exit from the area. Additional boxes shall be provided on each floor to obtain a maximum horizontal travel distance of 200 feet to the nearest box," (CFR 1910.163(b).). This means that fire alarm boxes should be located so that employees can give a fire alarm on their way out of the building where a fire has been discovered, enabling them to _____ .

    a. give warning

    b. escape

    c. both a. and b.

The first consideration in case of fire is always the saving of employees' lives. Plans should be made before any fire occurs to make sure that the sounding of a fire alarm bell or siren sets off a procedure for the rapid and orderly evacuation of personnel from the fire area. In this way, whoever discovers a fire will sound the alarm; and, as soon as the alarm is sounded, all employees will evacuate the area. Proper fire planning and periodic fire drills can help immeasurably when an actual fire occurs. Employees should know how to get to the closest fire exits and alternate exits.

Employees should know the location of telephones that can be used for calling the local fire department, and the fire department telephone number should be conspicuously posted.

ANSWERS TO QUESTIONS:

70. a. lack of equipment b. lack of training

71. a. Yes. It may seem obvious to say this, but sometimes employees don't realize how quickly a small fire can become serious and are reluctant to appear foolish by turning in an alarm.

72. c. Both; give warning and escape.

In case of fire, employees working in areas where gas shutoff valves or other special hazard shutoff devices are located should be practiced at finding them and turning them off. An employee should know how to shut down his or her machine, shut off flammable gas and fluid lines, and shut off the electricity.

Your local fire department is a readily available source of specialized fire protection information. Fire department personnel are available to inspect your workplace and give you advice about how to correct any fire hazards that exist. At the same time, you can assist fire department personnel in familiarizing themselves with the floor plan of your facility; the location of shutoff devices for electricity, gas, and other special hazards; and the type and arrangement of your facility's fire protection system, water standpipes, and fire hydrants. This kind of information exchange is of material benefit to your establishment and the fire department in preventing fires and extinguishing fires.

In addition to the fire hazard involved, some work processes such as those involving sparks or molten metal which can splash, present a higher than average risk of employees' getting burned. Employees in workplaces like these should be trained in first-aid treatment for burns. Sources of first-aid information and training are discussed in Lesson 10.

In addition to the FEDERAL REGISTER, other publications to refer to for information about fire protection are:

Publication	*Author/Organization*
Modern Safety Practices	DeReamer, R.
NFPA Inspection Manual	National Fire Protection Assn.
Fire Protection Handbook	National Fire Protection Assn.
Industrial Safety	Blake, R. P.

More complete information about these publications appears in the bibliography in Lesson 14. In addition to these publications, many others are available.

Fire Loss Control is a broad and comprehensive field. Colleges and universities offer degrees on the subject. The federal government, state governments, and private research foundations are currently spending thousands of dollars on research and studies relating to fire and fire loss control. There is a great deal of literature on the subject. You are encouraged to continue your studies should you wish to learn more about fire loss control than the basic information presented in this lesson.

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